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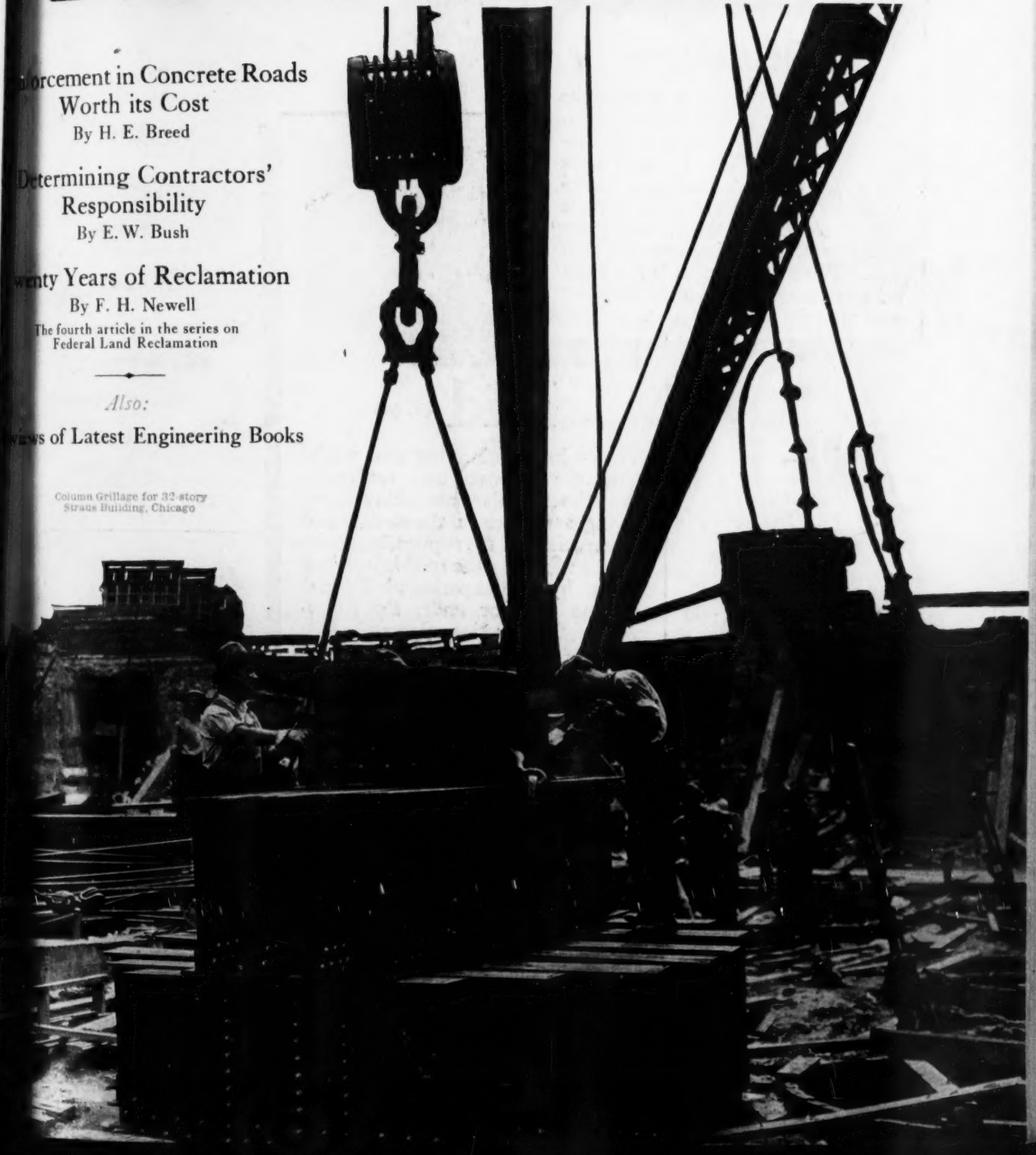

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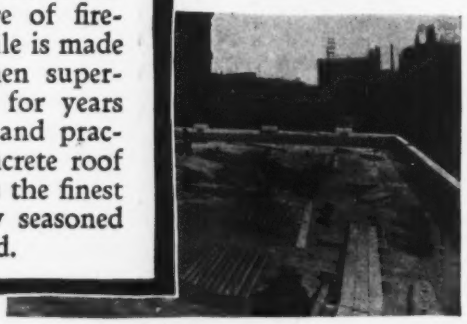

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Tax Economics

THE best test of a tax is the return it brings. Secretary Mellon has shown that the excessive supertaxes defeat their own purpose in that the large incomes are annually paying less to the upkeep of government. That these supertaxes are also encouraging tax-exempt bonds with accompanying municipal, county and district extravagance is secondary though important. The Secretary of the Treasury puts the question squarely up to Congress. Shall we continue our present system of taxation and pile up a Treasury surplus at the expense of a proper industrial expansion and out of the pockets of the middle class salaried man, or shall we continue to bow down to the class antagonism which demands a theoretical high tax out of large incomes whether that tax brings in any return or not? Economics and sound finance are on the side of the Secretary of the Treasury. Whether politics is remains to be seen.

Temporary Football Stands

COLLEGE football gatherings last week produced in one day two failures of temporary seating stands, which sent several score spectators to the hospital with serious injuries. Failures of this kind have become increasingly frequent as the assembling of large crowds at sport events has increased, and on the present record temporary stands must be set down as a distinct danger to public safety. Unlike permanent stands, they usually do not receive engineering attention in design and construction. They are decided upon in haste and are entrusted to the rule-of-thumb methods of a carpenter boss; and, representing a speculative expenditure for one-day service, they are apt to be bargained for at lowest price. While such conditions might seem to be most hazardous in the case of a private promoter's enterprise, the irony of fate makes the amateur football stand much the greater hazard. Engineering and architectural skill is ready to hand, in a college town, but it does not seem to be made use of when temporary stands are wanted. From the outsider's viewpoint it is the obvious duty of college authorities to make sure of the safety of their temporary stands before throwing them open to the visiting football crowds. But we fear that under present circumstances, if a stand collapse were to be investigated searchingly to determine how the authorities had carried out this duty, they would not make a wholly creditable showing.

Reinforced-Concrete Roads

THE case for reinforcement of concrete roads is well argued in this issue. There will not be entire agreement of engineers that wire mesh is the superior form of reinforcement, but this may be passed in the satisfaction that engineers, who have long urged that steel had a useful place in pavement slabs, will gain in having their practice so vigorously supported by Mr. Breed's discussion. Great strides have been made in three years in concrete road slab design. The separation of the slab into two spans by a longitudinal joint, the doweling of all joints, the thickening of the edges of slabs, and, above all, reinforcement itself are all common practices today. And none of these new practices has been more widely taken up than reinforcement. Each year has seen those states which began with a light mesh of steel to check cracking increasing the weight of metal used in the body of the slab and strengthening points of local stress with supplementary bars and frames. There is less need now than a few years ago to bring proof that reinforcement has its use in pavement for rural roads but there is still a world of knowledge required concerning the principles and technique of pavement reinforcing. These subjects both need more consideration than they are receiving in the everyday practice of road design.

Engineering Plus Adventure

RARELY has a group of engineers had a more spectacular or exciting three months than had Colonel Birdseye and his associates this summer at the bottom of the canyons of the Colorado. The running story of the trip in this week's issue is as absorbing as any tale of adventure. It satisfies, as few engineering reports do, the fictional notion of the engineer's life. But more than that it is the initial story of an exceptional engineering investigation carried out under the most adverse circumstances with what appears to be satisfactory success. The Colorado River is to be the scene of some of the most important engineering work of the next generation but that work cannot even be projected properly until more is known of the nature of that practically untraversed canyon, a part of which has become famous for its scenic beauty. This knowledge the Birdseye party set out to supply insofar as a reconnaissance could supply it. This voyage down the Colorado was in reality a preliminary survey with a line of levels carried through with remarkable accuracy, and included a study of dam sites and a record of stream flow, in addition to a fair amount of topographic mapping. When it is remembered that the trip itself, devoid of any of the surveying accessories, has been made only two or three times and, with the exception of the pioneer Powell trip only as an adventure, the Birdseye expedition becomes a notable addition to the annals of engineering.

Work for Engineering Schools

INDUSTRY is going to need 400,000 more persons for positions of responsibility by 1930 besides the replacements in the 1,500,000 administrators and technical experts now employed. This is the conclusion of the National Industrial Conference Board from an extension of current statistics and a consideration of the growing complications of industry. These figures are easy to believe but the collateral assumption that this means a

proportionate burden on the engineering school is not so convincing. It is no doubt a fact that industrialists generally are beginning to have a much better appreciation of the advantages of a technical education in the administration of industry but engineers should not delude themselves into believing that the future executives are all coming from the engineering profession. The report of the Board, abstracted in this issue, partakes of the common failing of industrial leaders of considering the problem of engineering education mainly the most efficient production of human material to fit into the major gears of the industrial machine. Insofar as the changing industrial process is to call for more and more engineers to do strictly engineering work the Board's conclusions are sound. Engineering schools must prepare for a growing increase in that demand. As to the necessity for an engineering training for the future administrator it depends on what one calls an engineering training. From the Board's report and the suggestions of similar nature that industry occasionally offers the proposed training is industrial rather than engineering. It may be that the engineering school can furnish such training better than any other but it should be clearly understood that the products of it are not so much engineers as they are industrialists.

Another Study of Education

THIS problem of fitting engineering education to the needs of the future is so important that engineers will welcome the decision of the Carnegie Foundation to spend $108,000 to supplement the earlier study made by Dr. C. A. Mann some years ago. The new investigation will be made mainly by the colleges themselves under the direction of a man exceptionally well equipped for the job. Mr. Wickenden has had the dual experience of being an engineering teacher and an industrial leader and in both capacities has made a brilliant record as a student of personnel and training. Any study under his lead, therefore, will have both solid foundation and vision, both of which are sorely needed today in engineering education. One word of suggestion only may be made. The proposed study, though initiated by the Society for the Promotion of Engineering Education, has been surrounded with a good deal of the same kind of thinking that marks the report noted in the preceding paragraph. The men back of it apparently have had the promotion of industry foremost in their thoughts. This is admirable but those who are to spend the Carnegie Corporation's money must not forget that after all there is an honorable and necessary profession of engineering which cannot be made merely the handmaiden of production. If it were to become so the progress of the world would be seriously retarded.

Engineers in Public Service

ENGINEERS in Chicago recently got a layman's frank view of themselves and their profession that was both appreciative and inspiring. Col. A. A. Sprague, commissioner of public works, chief of staff of the Thirty-third Division during the war and president of one of Chicago's largest commission houses, in addressing a noonday meeting of the Western Society of Engineers stated that no men were more needed in the activities of a city than the engineers, but the entire absence of engineers from all bodies selected directly by the citizens he deplored as unfortunate both for the city and the profession. Mr. Sprague asked if there were some inherent restraint in the engineer tradition that kept engineers from elective offices or whether it was merely choice. By this time engineers must realize they must work out their own destiny. If engineers want to get into public life individual engineers must do it and when they do attempt it the profession must stand back of them. The muddle in the Reclamation Bureau is a point in question.

As to inspiration and activation, Mr. Sprague made four points: The engineer can develop *honest* fact-finding; he best can apply those facts to the proper growth and development of a city; he can help obtain public approval and he can and must co-operate with men who are not engineers without intellectual or technical snobbery. On these last two points Mr. Sprague gave some very wholesome advice which the 300 engineers who overcrowded the room took without wincing. "When engineers are able to humanize their ideas so that the public can understand them, accept them and sense their benefits it will be a progressive step of far-reaching importance, but remember," he said, "you have got to be real human beings yourself before your words will be human. You men have got to help bridge all these human difficulties which are based on human misunderstandings that can be improved. The human factor in all labor and in all achievement is a part of your problem. It lifts the profession out of the mechanical and material and into one of those vital professions which are most worth while."

With leadership like this it is easy to see why the engineering department of the City of Chicago, for the first time in years, is happy, contented and has become once more a "good place to work."

Power and the People

LAST week the voters of the State of New York defeated by an overwhelming majority an amendment to the constitution permitting the development of water power on the state lands in the Adirondack forest. The vote was important to New York because it holds back for an unknown period the imperative development of the power resources of the state, but it is more important as an indication of the temper of the people in this critical issue of power. If this temper is general—and there is no reason to believe that New Yorkers are unique in this respect—the vote is most significant and the kind of thinking it represents must be studied and reckoned with by all concerned with power development.

The present constitution permits the use of 3 per cent of the Adirondack state lands "for the construction and maintenance of reservoirs for municipal water supply, for the canals of the state and to regulate the flow of streams." The proposed amendment provided that this same 3 per cent could be used "for the development of water power for the public benefit, and for the construction, maintenance and operation thereon of ponds, structures, conduits and appurtenances necessary for that purpose." Such development might be by the state or by a lessee of the state under state regulation. Transmission lines were specifically included in the appurtenances but manufacturing or business was prohibited on the state lands. There are about two million acres in the state domain, but by any plans now known only about 2,000 of the permitted 60,000 acres could be used for the power purposes outlined in the amendment. In other words, an extremely small part of the wild land of the state was to be utilized, possibly by the state

itself, possibly by private interests whose profits and rates would be controlled by the state, to develop about a million horsepower by the formation of a few artificial lakes in a country already spotted with natural ponds, the erection of some sightly power houses and the construction of some transmission lines along narrow lanes cut through the forest.

The opposition to the amendment came from two sources—first, the group of nature lovers, made up partly of the private owners of Adirondack land, mostly wealthy men with large forest preserves inaccessible to the general public, and partly of the vociferous minority who make a holy cause of any practical utilization of nature's resources and second, the advocates of state owned power, who are also the opponents of any private power development. The arguments of the two groups were in many respects in mutual opposition, but this they calmly disregarded and worked together to such good effect that practically every influential newspaper in the state came out against the amendment and its only public defenders outside the power companies were a few engineers who have been studying the power resources of the state.

In effect, the arguments against the amendment were as follows: (1) It might prejudice the state's future ownership of its water power; (2) it would destroy the beauty of a state park by the erection of disfiguring power houses and appurtenances and (3) it would permit the exploitation of public resources by private interests (for publicity purposes known in all the literature as the "water power barons") with no compensation therefor. Here is, of course, a curious mixture of state ownership and the nature lover. Just how a state owned power plant is to be less disfiguring than one privately owned was not made clear—but at any rate, and this is the significant thing, enough people accepted one or the other view to defeat the amendment by half a million votes.

The campaign against the amendment and the vote make one thing very clear—there is need of a vast amount of education in the matter of power development. In spite of the experiences of the past few years the people generally take as an amiable scientific prophecy that there will be no more coal in a few generations. It apparently has about the same effect as the recurring predictions of the diminution of the sun's heat. There is, besides, a dense ignorance of the real nature of hydro-electric development. It has not penetrated the general intelligence that for widespread electric transmission economic design requires that steam generation must accompany water generation and that during this period of growing scarcity of coal it is only by the tying in of the available water power to properly located steam stations that electric energy can be delivered at the lowest cost. Further than that, many scattered hydro plants must be tied together to take care of the variations in flow and demand. It follows therefore that for the greatest economy the state, if it develops its own water power most economically for the public good, must either co-operate with the private companies in the distribution of energy or operate its own coal burning plants.

It is possible, of course, that in time our social development may lead to one of these two contingencies but we very much doubt if that time is near or that many of those who voted against the amendment desire either one. Most of them were obsessed with one of two notions, that power development in the Adirondacks means a ruthless destruction of natural beauty or that even with state control there is inordinate profit in the private development of water power. Neither of these two notions has any basis in fact, but merely to state that has little influence with the public. They need to be educated in the elementary principles of power development, so that they can judge more wisely when such issues as this one arises. If in the long run the people of the United States want publicly owned power they are going to have it. That is what democracy is. But it behooves those who believe that for the next fifty years at least the general good is to be better served by private development to do all they can to put the facts before the people so that they will not be governed by such silly and contradictory arguments as prevailed in New York last week.

A Record and a Promise

LAST spring when everything else seemed to point to a season of unusual prosperity it looked as though the railroads, through their inability to handle the increased traffic, would put a costly check on an otherwise successful year. They were still years behind on their normal betterment program, behind on their maintenance work, without capital for new work, and lacking the ability to raise much new capital because of their low earning power. But the American Railway Association, realizing, probably, that the success or failure of the performance of the railroads in the ensuing months would largely determine the attitude of the new Congress towards them, and realizing as well that if the situation was to be handled successfully it must be done through increased efficiency, set out to increase the number of cars available for the transportation needs of the country by increasing the miles per day per car and the load per car, and also decreasing the number of bad-order cars and engines waiting repairs. In addition to this the railroad companies took advantage of equipment trusts as a means of purchasing rolling stock.

The record of how well this program of increased efficiency was carried out is now a matter of history; approximately 115,000 new freight cars and three thousand engines, a smaller percentage of engines and cars in need of repairs than ever before, the average mileage per car per day increased from 22.5 for the first nine months of 1922 to 27.6 for the same period in 1923, and an increase of 31 per cent in the ton-miles per day.

This is a record of which the railroad companies may well be proud but the best part of it is that it has spurred them on to outline a more comprehensive plan for next year. This plan includes a field of co-operation and use of joint facilities never tried before. Its success will largely depend on the continued confidence of the railroad operating officials in the security of their properties and their ultimate return to a paying basis. As long as they feel that in the near future they will be able again to invite new capital to invest in the railway field so long will they work toward more efficient operation. But once they feel that that their companies are going to be kept from earning a fair return on the capital invested just so soon can the American people expect the collapse of their great railroad structure. The railroad performance in the past ten months has demonstrated that the Transportation Act is, on the whole, fairly just and workable. The incoming Congress will do well if it devotes its attention to its improvement rather than to its destruction.

Reinforcement in Concrete Roads Worth Its Cost

Experience and Experiment Both Give Proof of Increased Strength and Endurance — Quantity and Distribution of Steel Main Problem —Fabric With Edge Bars Best

By H. Eltinge Breed
Consulting Highway Engineer, New York, N. Y.

REALIZATION of the basic value of concrete roads and concrete bases has made highway engineers seek zealously to eliminate their defects. Comparison of the use of concrete in highways with its use in structures directed attention at once to the value of steel as a method of giving additional strength. In concrete structures such as buildings and bridges, the use of steel for reinforcement was accepted good practice, and the theory of relative quantities to secure a given strength had been worked out to precision. Obviously, the use of steel in the concrete would give additional strength to highways. But would the expense be justified? It was argued that it would not; that whereas in buildings steel was a necessity to give them rigidity, it was not necessary on a flat surface that had the bearing power of the whole earth beneath it. But meanwhile cracks were developing in the concrete and concrete-base roads, and it became apparent that the bearing power of the whole earth varied widely on different portions of its surface. Other remedies having been tried without success, small quantities of steel were introduced to try to bind together the slab. The results were so encouraging that the use of steel as a binding agent in concrete roads has become general.

Experiment having indicated that the use of steel was advisable as a binding agent in concrete roads, the problems remained of how much steel it was advisable to use, and of how best to distribute it.

Distribution—Cracks first occur when the cement is setting. When cement hydrates the chemical action involved generates heat, and shrinkage inheres in the process of cooling after setting rather than in drying out as was formerly thought. During shrinkage a binding steel is insurance against the progression of cracks, and the greater its distribution the more effective it will be. For instance, in wire with a 6-in. spacing a crack starting at the center of the mesh can progress only 3 in. before it strikes a steel binder that checks it. Thus reinforcement insures against the spread of any cracking that may be started by the stresses involved in the setting-up and curing processes. With the greater distribution of metal there is greater uniformity of strength in the concrete.

Whereas wire fabric provides uniform reinforcement, the tendency of the slab itself is to weakness at the edges. It is wise therefore to give edges additional strength by the use of a steel marginal bar or a thickening, and to hold the slabs together with an interlock or dowels so as to prevent unevenness at the joints and consequent impact.

Amount—For several years opinions varied about the amount of reinforcement it was advisable and economical to use. Two types came into general use, wire fabric and bars. Wire fabric weight for weight and area for area gives greater bond strength than bars on account of the fact that it has a greater superficial area. That wire fabric has more strength than bars weight for weight and area for area has been demonstrated by tests of the Pittsburgh Testing Laboratory. In these tests:

Three ⅜-in. round bars of 0.1093 sq.in. average area showed an average strength of 66,663 lb. per square inch, while five No. 8 wires, with a total area of 1.005 sq.in., showed an average strength of 83,490 lb. per square inch, or 25 per cent greater strength. Similarly, three ½-in. round bars with an average area of 1.982 sq.in. showed an average strength of 60,063 lb. per square inch, while eight No. 7 wires showed a total of 0.1944 sq.in. of area and an average strength of 81,237 lb. per square inch or 35 per cent more strength.

Small units of wire fabric reinforcement, because of more complete distribution of the metal, have greater tensile strength and bond strength than larger units of the same total weight and area spaced more widely.

There are other practical advantages of wire fabric that recommend it as a method of reinforcement, such as ease in handling, insurance of full quota of metal, greater facility on making street cuts through the pavement, closer approach to surface, and direct contribution to strength of pavement.

Placing—Most specifications now require that the wire fabric be supplied in sheets. These sheets are shipped in bundles and deposited by the roadside. The wires that bind them together are snipped, and two men, one at each end, lift each sheet and place it. With material woven into a web, no opportunity is afforded to omit any part of it. The engineer on the job is probably on his rounds before the wire fabric is covered, or if he has been absent and wishes to ascertain that it has been laid, he need only drop a hook through one place in the green concrete.

Since the surface is the area of disintegration, the support should be laid as close to it as is consistent with protection from abrasive wear. The generally approved depth at present is 2 in. below the top. It is extremely important that the fabric be *laid in place* at this depth, and not be simply dropped anywhere in the slab to find its own abode. The carelessness of the latter method has been found by test and experience materially to decrease the value of the reinforcement in preserving the integrity of the slab.

Proper placing of the reinforcement may be accomplished in two ways. The earlier, still most widely-used method is to screed off the pavement at the required depth, usually 2 in. below the top. This is done to remove any irregularities that would prevent the fabric from lying smooth. Then the fabric is placed on this bed and covered with the specified thickness of concrete. There is no opportunity for the metal to bridge or for voids to form under any part of it. There are, if the contractor wishes, two machines now on the market to strike off below the surface. The laying of the concrete above the fabric is accomplished equally well by either the chute or bucket type of discharge, requiring only a little more rapidity in its distribution, which means ultimately a saving in the

contractor's time. If, however, he wishes to avoid the extra operation of screeding, although it is done by men in the time when they would otherwise idly be waiting their turn in operations, he may use the new method of laying.

This second method involves only one pouring and no additional screeding. The wire fabric is laid on a support of thin iron plates set on edge to the desired position. The concrete is then poured through the wire to the required depth and above it to the surface. Then the iron plate supports are slid along by the movement of the mixer, to which they are attached, to be in position to receive the next section of reinforcement.

Openings—Where street openings must be made through the pavement, the rupture of the wire can be accomplished instantly with a pair of wire cutters. A 5- or 6-in. margin should be left between the edge of the opening and the ends of the wire mesh, so that the wires cut may be bent back into loops to which new fabric may be attached when the disrupted area is repaired. When sections of pavement must be torn up, a simple inlay thus renders intact the strength of the reinforcement.

Cost—It would seem that so far as service goes the concrete road reinforced with wire fabric meets the increasing requirements of modern traffic. How about the cost?

We know that reinforcement data compiled by the Ohio State Highway Department show the annual cost of maintenance of plain concrete as compared with reinforced concrete roads. *Engineering News-Record* for July 12, 1923, says that the total yardage of plain concrete roads built in Ohio prior to Jan. 1, 1923, was 4,767,366 sq.yd. The total maintenance cost for the year 1922 was $106,986, or an average cost of $0.0223 a square yard. This would be an average cost of $209.33 for each mile of plain concrete pavement 16 ft. wide. Of concrete reinforced circumferentially and with wire fabric there was laid up to the same date 2,921,002 sq.yd. with a total maintenance cost of $14,289 or an average of $0.0043 a square yard. This would mean $40.36 for each mile of 16-ft. pavement, a clear saving of $168.97 for every mile, every year.

Actual experience moreover, indicates that the reinforcement prolongs the life of the pavement at least one-fifth. Taking the general average of the life of a concrete pavement to be 20 years, the reinforced pavement will last 25 years. Multiplying the life of the reinforced pavement by the yearly saving in maintenance, we have a saving of $4,225 to offset the $1,120 it originally took to reinforce that particular mile, a clear saving of $3,105. With that in view it behooves any municipality whose annual maintenance charges are over $0.14 a square yard to consider the wisdom of making a capital investment that will be refunded in maintenance savings.

The conclusion is then that from the standpoint of the public, of road-builders and of engineers, concrete pavement or base, reinforced with wire fabric with edges strengthened and with joints interlocked or with dowels at the joints, adequately meets the requirements of modern traffic.

Bates Road Tests—The truth of this conclusion is sustained by both experiment and experience. The experiments made on the Bates experimental road in Illinois have been of world-wide significance. In July, 1922, the writer inspected the road. At that time five series of loadings had been run over many different types and variations of pavement laid contiguously, and the destruction of many sections had resulted. It was evident then that plain concrete bases under 6 in. thick were not adequate; even one section 6 in. in thickness showed the beginning of failure.

Since then traffic has been continued, with increased loadings, until a total load of 16½ tons has been used, 13,500 lb. on each rear wheel, in the final runs. In all, over 1,000,000 tons of traffic have been carried. On July 17, 1923, with two more days of the test still to run, only one section with an 8-in. concrete base as foundation for other types of surfacing than concrete was left intact. Definite conclusions should be drawn only from the results of the full test which are not yet available, but this much is evident: the top surface does not protect the base slab from ordinary stresses; and the contrast between the plain and the reinforced-concrete sections of the same thickness and proportions indicates that reinforcement in the bases would be a decided help.

On July 17, 1923, the Bates road had still in service a 6-in. section reinforced with 45 lb. per 100 sq.ft. of wire fabric reinforcement. After subjection to 1,000,000 tons of traffic with loadings up to 16½ tons, this slab is in good condition. The one break in the corner that developed last year was due to impact caused by the failure of the adjoining slab 5 in. in thickness. The cracks that have developed are fine and in four instances have stopped without progression through the slab. All of the cracks are well held together with no spalling or breaking down. The present condition of this slab indicates strength from the fabric reinforcement adequate to the test, which was extraordinarily destructive, half of the total tonnage running on the edge of the pavement, which had no edge strengthening.

Reinforced Bases—That the results of these tests is confirmed by experience is shown by recognition by many engineers who are specifying that their bases under asphalt, brick, wood and stone block, etc., shall be reinforced. High Holborn Road, London, is being rebuilt with a 9-in. reinforced concrete-base using a wire fabric reinforcement for a wood-block pavement. Fulham, London Metropolitan District, is laying wood-block pavement on a 9-in. and 10-in. concrete base reinforced with wire fabric. Holborn, London Metropolitan District, is laying a first-class paved road with a 2-in. asphalt top on a 9-in. concrete base reinforced with a wire fabric.

In this country concrete bases are being reinforced in Richmond, Va., where 40 lb. of wire fabric is being used in a 5-in. concrete base under brick, durax, and asphalt surfacings. In Hudson County, New Jersey, a reinforced-concrete base is laid under granite block across the soft marshes of the Jersey meadows. Other cities like Augusta and West New York are using the reinforced-concrete base.

Examples—The writer's observation and experience corroborate the results of experiment. In 1920, in a pavement in Bennington, Vt., he used 40 lb. of wire fabric per 100 sq.ft. on the narrow sections of the street on either side of the car track under medium to light traffic. Three years later, after an unusual increase

in traffic, there are very few cracks with no opening up. The maintenance has been $0.002 per square yard per year.

Other reinforced-concrete roads that he inspected nearly three years ago were the Fort Lee Turnpike in New Jersey and the Kearney County Road; the William Penn Highway in Pennsylvania; the Grand River Road in Wayne County, Michigan; the Albany-Schenectady Road in New York; the Babylon-Bayshore Road on Long Island; and city streets in Paterson and Ridgefield, N. J., and in Beacon, N. Y. *Engineering News-Record* of Dec. 23, 1920, gives details of these pavements and others.

In every one, the three years' additional service has made more apparent the beneficial effects of reinforcement. The reinforced-concrete pavements have held better than near-by plain concrete pavements under similar conditions. This was to be expected. The significant point is found in the cost data. As far as the writer has been able to obtain it in detail, it shows that the lower maintenance of the reinforced pavement offsets within half its life the additional cost of the reinforcement.

Conclusion—Considerations of theory, practice and use lead to a tentative recommendation for what is vaguely known as the "average" case. From the "average," each highway problem will vary in respect to some factors still indeterminate such as bearing power of sub-soil, moisture content, temperature stresses, etc. Where sufficient basic facts have not yet been ascertained, we still have to design on empirical generalizations based on observation of the trial-and-error method. Varying conditions require corresponding variations in treatment, to be determined in each particular case. To apply a blanket recommendation to all highway conditions would provoke disaster as certainly as would the taking of a general cure-all for every known ailment. The following applies to the reinforced-concrete base as well as to the reinforced-concrete pavement.

First consider the country road. Service conditions and test roads have shown conclusively that the unsupported corner is the weakest spot in the slab. Next comes edge weakness, and then longitudinal weakness of slab when subjected to beam action. Provision can be made for edge weakness and the unsupported corner by thickening the edge or using the marginal bar. The bar should be turned across the pavement at the ends of the slab. Continuity of the slabs is secured by tying together the slab ends by ¾-in. plain dowels, 4 ft. long, spaced 2 ft. on centers, with one end encased to allow them to slip or by interlocking. To strengthen against beam action a division of the roadway can be made by a central division plate with the addition of fixed dowels to hold the two slabs together, which increases the beam strength of the half slab four times that of the full slab.

Cracking caused largely by variable factors, cannot be prevented entirely with any amount of metal we can afford to use. The use of a wire fabric reinforcement however checks the extent of the cracks, distributes them and interlocks the different sections of the slab into a unit, so that it prevents the cracks from becoming a destructive factor and reduces maintenance to a minimum. For this result 35 to 65 lb. of metal per 100 sq.ft. has proved effective in actual service for periods exceeding five years. Service conditions have shown also that a fabric with a ratio of two to one or three to one laid longitudinally in the pavement gives good results in the divided slab but the general tendency is for an equal distribution of the reinforcement in all directions.

The city or village street presents a different problem from that of the country road. In the former the same edge and corner weakness is less likely to cause destruction both because of the loads are rarely so near the edge, and because the sidewalk, curb, gutter and storm drainage keep the subgrade covered and free from excessive moisture changes.

The treatment of the slab design depends on the way the pavement is divided from curb to curb and the width of the street. With good foundation conditions 6 in. would be a minimum of thickness with 42 lb. of metal per 100 sq.ft. of surface corresponding to a 6x6-in. spacing of No. 6 wire placed 2 in. below the surface, giving equal distribution in all directions. The slab ends should be tied together with dowels or by interlocking as for country roads. In addition to this, edges of the slabs subjected to traffic should be strengthened by the use of a marginal bar, thickened edge, or both, as the conditions require.

The advantages of the reinforced-concrete pavement are practical and obvious. Beyond them lies a deeper satisfaction. There are many tendencies in American life that are cheap, extravagant, pretentious and ugly, but there is a steadily increasing force of opinion demanding intensive worth and sound value rather than extensive display. Working in harmony with that force, one is building for a better future. It is that hope that encourages us to look beyond supplying the immediate needs of transportation to promoting permanent improvement in highway work.

North-South Railway for Australia

A railway connecting the well-settled part of Australia along the south coast with the thinly settled section on the north coast, which has been projected at intervals for many years, is again under consideration. One purpose is to open certain inland sections for development, although part of the country is desert, but a secondary purpose is to develop northern ports and thus give shorter steamer routes to other countries. There is already a transcontinental telegraph line. From Port Darwin, on the north coast, in federal territory, a railway extends south to Katherine, about 200 mi. From Port Augusta a line of the South Australian Government Rys., connected with the general railway system, extends north to Oodnadatta, 478 mi. Between these two lines there is a gap of about 1,000 mi., and the cost of a railway is estimated at $68,500,000. Alternate routes have been proposed. A recent parliamentary committee has recommended a 150-mi. extension south from Katherine to Daly Waters and a 300-mi. extension as a light railway north from Oodnadatta to Alice Springs, which extensions are expected to be sufficient for several years. The lines are to be of 3½-ft. gage, laid with 60-lb. rails and probably with steel or concrete ties, if prices are reasonable, owing to the destruction of timber by white ants in the territory traversed.

Determining the Responsibility of Contractors

Determining His Acceptability as a Risk by a Reputable Surety Is Determining the Contractor's Responsibility

By E. W. Bush
Engineer, Aetna Casualty & Surety Co., New York, N. Y.

The committee on ethics of the Associated General Contractors, as noted in Engineering News-Record, *Oct. 11, 1923, pp. 583 and 616, are studying the elements that determine the responsibility of a contractor. The question is of importance to engineers when receiving bids or awarding contracts to "the lowest responsible bidder," also to contractors when placing sub-contracts. We have asked E. W. Bush, engineer of the Aetna Casualty & Surety Co. to give us the viewpoint of the sureties on this subject. His reply follows.*—Editor.

REPUTABLE sureties desire to write surety bonds on construction contracts for responsible contractors only, and the various bond-application forms, the financial-statement forms and the information schedules which are used have been prepared to disclose the contractor's responsibility. From the information received the surety forms an opinion of the client's responsibility and then, if the opinion is favorable, backs it with its financial strength and assumes the obligations of suretyship on the contract bonded. The underwriting of a contract is, as a matter of fact, the determining of the contractor's responsibility.

The Associated General Contractors' Committee has listed the following elements of responsibility:

1. Financial condition, bank credit and bank references.
2. Experience of person who will manage or direct the construction operations.
3. Plant available for the project.
4. Construction performance record.
5. Personal references for successful construction service.

The five elements listed are important, but, in general, they are not sufficient for sureties to act upon. Before being committed to the bond on important contracts they like the following additional facts, which, as explained later, are also elements in determining the desirability of the business, hence the "responsibility" of the contractor, for the project being considered.

6. Information regarding the proposed work, giving the kind of work, the location, the amount of the contract, the bid prices, and the other bids, if the bids have been opened. A copy of the contract documents is desired, also the names and addresses of the sub-contractors and the kind of work and amounts that will be awarded to them.

7. List of the other contracts on hand giving in regard to each the amount, kind, location, and approximate percentage completed, also whether or not each job is progressing satisfactorily and on a profitable basis.

Contract bonds are not liability insurance but are a form of credit because they increase the financial strength of the contractor to the owner by the amount of the bond. They are underwritten on much the same basis that a bank uses when extending a loan to the contractor—and for the same reasons. A bank meets with losses but never makes a loan if it thinks there will be a loss; in the same way a surety never writes a bond if it thinks the contractor will not be able to complete the contract without the owner calling on the surety.

There is a limit to the amount of bonding credit a reputable surety will extend to every contractor just the same as there is a limit to his banking credit. Assuming that the contractor is honest, experienced in the kind of work considered, bears a good reputation, has adequate plant and organization, and the work is ordinary in character, this limit is fixed by the relationship existing between:

(a) The contractor's net quick assets;
(b) His total net worth; and
(c) The volume of work to be performed. (The new work plus the incompleted portion of any contracts on hand.)

As a general underwriting rule, many reputable sureties like to see (a) not less than 10 per cent and (b) not less than 20 per cent of (c). With the same assumption regarding the contractor, the above makes a very good working rule to determine the contractor's responsibility in regard to any particular project or for work up to a certain aggregate amount.

Sureties frequently vary this underwriting rule depending on the size and nature of the work, the adequacy of the price, the previous success of the contractor in estimating and performing similar work, the profits being obtained on the other work on hand, whether or not the labor or material markets are stable and whether reinsurance can be obtained from other sureties. About the only underwriting rule that never changes is this one, namely, "The more favorable information the surety has about a contractor the greater will be his bonding credit." Reputable contractors and reputable sureties are both interested in eliminating the irresponsible bidder, and this will eventually be done if the best contractors will encourage the sureties to make a full investigation before writing the bond and they will give the sureties full information regarding their affairs. They can stand the investigation, whereas the irresponsible ones cannot.

A word is in order regarding financial statements because the net quick assets is an essential element in determining responsibility. The nature of the business requires contractors frequently to borrow large sums from banks in order to avoid a default and the amount that can quickly be raised is determined largely on the contractor's net quick assets. The quick assets consist of the cash, the earned accounts receivable and retained percentage, notes receivable, the securities possessed by the contractor, and the materials on hand that will go into contracts on hand. Against these are placed the notes and accounts payable and debts incurred to the date of the statement. Other assets of a slower nature would include real estate, materials that will not be required in contracts on hand, and plant, also any claims against others.

A mortgage against real estate is a slow liability, but while the plant is a slow asset a note given in payment for plant should be included in the quick liabilities because if it is not paid the contractor must go into the hands of a receiver. Money cannot be quickly raised on second mortgages nor on investments in speculative enterprises, and many notes receivable cannot be discounted. A contractor's plant is something he needs in his business, therefore he cannot sell it to finance his work. Banks, sureties, and others dealing with credits

are apt to scale down asset items which are obscure or of doubtful value, so it is desirable that a full explanation accompany each financial statement in order to have it appraised at its real worth.

The writer refers those interested in this subject of responsibility of contractors to the 1922 volume of the "Transactions of the American Society of Civil Engineers." E. A. St. John, vice-president of the National Surety Co., has an article on contract bonds, starting on page 1052; and E. C. Lunt, then vice-president of the Fidelity & Casualty Co., has a similar article starting on page 1058. F. S. Greene and H. S. Sisson have short articles on pages 1066 and 1068, respectively, that touch somewhat on this question, and the writer contributed a discussion to be found on page 1091.

Seven Plants Fabricate Steel For Chicago Building

Contract for 12,000 Tons Is Divided to Expedite Construction—Heavy Column Sections on Large Foundation Piers

DIVIDING the steel fabrication contracts among seven firms to insure rapidity of progress was the unusual step taken in the construction of the 32-story Straus Building now being erected for S. W. Straus & Co. at Michigan Ave. and Jackson Boulevard, Chicago. For 22 stories this building will be 172x161 ft. in plan, with a central light court about 56x50 above the fifth floor. Above the 22-story structure there will be a 10-story tower with a pyramidal roof surmounted by a 28-ft. sculptured group whose top will be about 475 ft. above the street level. The exterior finish will be of Bedford stone.

FIG. 1—GRILLAGE FOR COLUMN IN STRAUS BUILDING, CHICAGO
Two courses of plate girders and top course of I-beams with steel slab for column footing.

FIG. 2—HEAVY COLUMN SECTIONS AND GRILLAGE

When the work was being planned early in the spring of 1923, it was found that it would be impossible to have any one plant fabricate the 12,000 tons of structural steel work within the required time so that the building would be ready for occupancy by May 1, 1924. To meet this condition, the owners divided this part of the work into sections and placed the contracts with seven fabricating plants in five states, each plant being required to have its material ready by a certain date. In this way, the general contractor is assured a steady supply of material so that the work can go forward as planned.

These divisional contracts were not placed on a tonnage basis but on a tier or floor basis, so that the structural details could be completed with a minimum of delay. Each tier embraces two stories, except that the third tier includes three stories. In order to insure systematic and steady progress it was essential that an erection program should be arranged and that each successive contract should be completed by a specified date. In the accompanying table is given the approximate tonnage of each steel fabrication contract, with the date for completion of delivery of material.

All the steel is furnished by the Inland Steel Co., Chicago, and the way in which the fabrication contracts for structural material are divided is shown by the following list: Grillage for footings, Lakeside Bridge & Steel Co., North Milwaukee, Wis. Steel slabs for column bases, Hansel-Elcock Co., Chicago. First tier, Morava Construction Co., Chicago. Second tier, Vanderkloot Steel Works, Chicago. Third tier, columns, spandrel and interior girders, Minneapolis Steel & Machinery Co., Minneapolis, Minn.; other girders, Lakeside Bridge & Steel Co.; vault, Duffin Iron Works, Chicago; floor beams, Morava Construction Co.; two 68-ton 53-ft. girders over the main entrance, Phoenix Bridge Co., Phoenixville, Pa. Fourth tier, columns and

STEEL FABRICATION CONTRACTS FOR STRAUS BUILDING

Section	Material	Contractor	Approximate Tonnage	Date for Completing Delivery
Grillage	All	Lakeside Co.	540	Aug. 1
Slabs	All	Hansel-Elcock	60	Aug. 1
1st tier	All	Morava	1,000	Aug. 10
2nd tier	All	Vanderkloot	1,250	Aug. 20
3rd tier	Columns and girders	Minneapolis Steel	1,000	Sept. 5
3rd tier	Girders	Lakeside	500	Sept. 5
3rd tier	Floor beams	Morava	300	Sept. 5
3rd tier	53-ft. girders	Phoenix	150	Sept. 5
3rd tier	Vault	Duffin	150	Sept. 5
4th tier	Columns and girders	Kansas City Struct.	600	Sept. 15
4th tier	Floor beams	Morava	300	Sept. 15
5th tier	All	Vanderkloot	850	Sept. 30
6th and 7th	All	Hansel-Elcock	1,500	Oct. 5 to 15
8th to 12th	All	Morava	3,050	Oct. 20-Nov. 20
Tower	All	Vanderkloot	650	Dec. 5
Total			11,900	

court spandrel girders, Kansas City Structural Steel Co., Kansas City, Mo.; floor beams, Morava Construction Co. Fifth tier, Vanderkloot Steel Works, Chicago. Sixth and seventh tiers, Hansel-Elcock Co., Chicago. Eighth to twelfth tiers, Morava Construction Co. Ten-story tower, Vanderkloot Steel Works.

Grillage for the column footings is composed of two or three courses of plate girders and I-beams, varying in size according to column loads. A complete grillage with steel slab for column footings is shown in Fig. 1. In the lower course the girders are 24 to 36 in. deep and in the second course they are 20 to 36 in. deep. When there is a third course, 15-in. I-beams are used. Steel slabs varying in thickness from 4 to 8 in. and of a size to suit the columns, with a maximum of 32 x 36 in., are placed on the grillage to support the first column sections, which are approximately 30 ft. in height. These bottom sections of the columns were placed before the interior excavation was made for sub-basement and lower sub-basement spaces. The columns are of I-section, built up of web and cover plates and four angles. Some of the bottom sections are very heavy, as will be seen from Fig. 2. The bottom is planed to give a level bearing on the steel slab and has two angles bolted against the cover plates to hold the anchor bolts. Two steel guyed derricks with 123-ft. masts and 110-ft. booms are used in the steel erection.

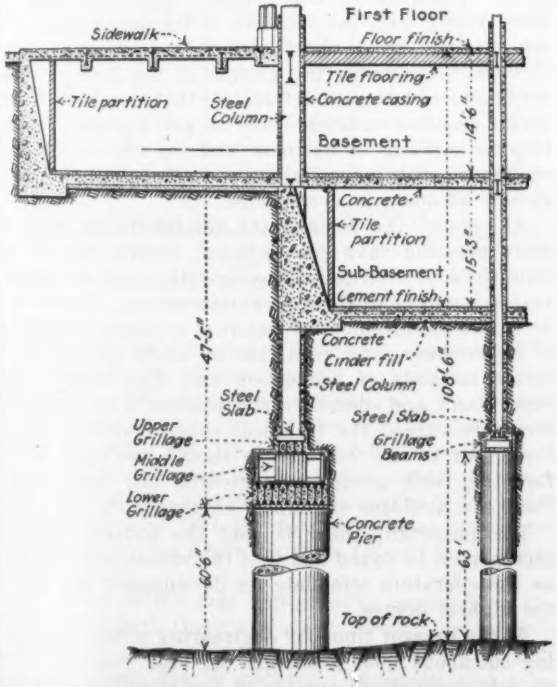


FIG. 3—FOUNDATIONS FOR CHICAGO 32-STORY BUILDING

Two other features of engineering interest in the construction of this building are the foundation piers, locally known as caissons, and the underpinning on the south and west sides of the site. The foundations consist of 78 concrete piers built in open wells sunk through the clay to bedrock at a maximum depth of 115 ft. below street level. Two of these piers are 11 ft. 9 in. in diameter and are said to be the largest ever built in Chicago foundation work. The concrete piers are about 60 ft. high, surmounted by the steel grillage and columns, as shown in Fig. 3.

Underpinning the old seven-story Leschin Building on the south side was particularly difficult, since the owners of the Straus Building were required to place piers on the property line to support a double party wall. Thus the wells had to be sunk under the existing wall. In the more general practice in cases of this kind, the piers are placed at a convenient distance from the property line and the wall is carried by cantilever girders. For the Leschin Building the underpinning was of the usual type, with transverse steel needle beams placed through the wall and supported by heavy timbers on the inside and outside of the building. These timbers in turn were supported by closely spaced screw jacks on timber blocking or cribbing. At the west end, some underpinning of the foundations of the Illinois Theater was necessary, but this was not difficult, particularly as an alley extends between the theater and the new building.

The new Straus Building is owned by the firm of S. W. Straus & Co., which will occupy the first six floors for its investment banking business. The architects are Graham, Anderson, Probst & White, Chicago. The Thompson-Starrett Co., Chicago, has the general contract. In direct charge of the construction are C. E. Harvey, superintendent for the architects, and N. J. Provost, superintendent for the general contractor.

Pier Construction on Rigolets Bridge

A correspondent reading the article entitled "Rigolets Bridge Built to Stand Hurricanes," in *Engineering News-Record*, Oct. 18, 1923, p. 626, was somewhat concerned about the possibility of damage in the concrete pier after the steel shell, in which the concrete piers were cast, rusts away. He felt that the steel angles bracing that shell would then be exposed to corrosion and being embedded in the concrete might set up forces which would break down the concrete on the face of the pier. Inquiry was directed to W. H. Courtenay, chief engineer of the Louisville & Nashville R.R., which built the bridge, and he replied that the whole of the 34-ft. diameter of these piers will be sunk below the bottom of the Rigolets and will be surrounded by sand and clay. The 28-ft. diameter shaft is built within concrete forms which are removed as the shaft is built up. This building up is done during the process of sinking. Upon completion of the sinking of these piers there will be no steel exposed to the action of the water except the steel of the 16-ft. diameter well shaft which has no angles entering the concrete.

Many Engineering Graduates Are Needed in Industry

400,000 More Trained Executives Needed for Industries in 1930—Should Be Well Grounded in Fundamentals

THE FIELD of the nation's manufacturing activities has been surveyed by the National Industrial Conference Board with the idea of determining the needs of the next generation in order to suggest improvements in the educational plans for today. The results of its survey are given in its special report No. 25, on Engineering Education and American Industry.

In approaching this subject the board has attempted to answer three broad questions: (1) Do the industries of the United States need more or fewer engineers than the number now being graduated from engineering schools and colleges? (2) What kind of men do the industries require from the engineering schools and colleges, and what should be the nature of their education? (3) What are the responsibilities of the industry in this matter?

The report cites the fact that the expansion of industry during the past few decades has been accompanied by vastly increased complexities of industrial operations, and the grouping of greater numbers of workers in corporate units has placed upon employers an increased social responsibility towards their employees and towards the life and affairs of the community. All of these changes have created problems of human, social and political relationship in which industry and society as a whole have become increasingly dependent upon trained technical and administrative leaders. The present demand of American industry for men with effective educational training for such leadership may be fairly gaged by the present ratio of persons in positions of responsibility to the total number gainfully occupied in the United States. Of the 41,600,000 persons who were gainfully employed in 1920, less than 4 per cent planned the activities and directed the energies of the whole working force. This 4 per cent includes major officials, officers, superintendents, technical engineers, designers, draftsmen, inventors, architects, chemists, assayers, metallurgists and auditors, together with one-quarter of the number of foremen, overseers and inspectors in agriculture, mining, manufacture, instruction, trades, transportation and public service. The report assumes that three-quarters of the foremen, overseers and inspectors are not sufficiently distinguishable from the group of wage earners and workers to be included in the category of those who plan, supervise and administer the business of the nation. According to these figures, approximately 1,500,000 positions in the business structure of the United States must gradually be taken over by youths who have the ability and who shall have received training which will enable them to assume the responsibility of various forms of major and minor leadership.

Looking Into the Future—The board finds that if the records of the past fifty years can be taken as a criterion, the 1,500,000 will be increased to 1,900,000 in 1930. Its study shows how rapidly since 1870 the number of administrators, supervisors and technical experts has increased; in 1870 the number was only 170,000, or 1.25 per cent of the total number of persons gainfully occupied. This increase has been particularly rapid since 1890, when the era of mass production began. The outstanding fact of this study is that the country must not only supply replacements for the 1,500,000 administrators and technical experts, but must also supply 400,000 more persons for positions of responsibility by 1930. The reason for this growth in the demand for experts and leaders lies in the change of methods by which industrial work is performed; methods of mass production greatly increase the amount of product per worker, but require a relative increase in the proportion of planners and administrators.

Talent Needed—Some idea of the kind of talent necessary for the industry can be obtained from the fact that 600,000 of the 1,500,000 administrators and technical experts in 1920 were engaged in manufacturing and mechanical industries, and it is estimated that 150,000 of the men and women classified as in professional service in 1920 are employed in or associated with these industries, so that a total of 750,000 persons, or approximately half of the total number in positions of responsibility, are connected with manufacturing and mechanical industries. A reclassification of these 750,000 persons indicates that they make up 5.79 per cent of the total of 13,000,000 persons engaged in manufacturing and mechanical industries, and that 4.51 per cent of the total are classified under owners of small establishments, superintendents of medium sized establishments, engineers, salesmen, and foremen. As the bulk of the men who rise to the chief executive positions of the medium sized and larger establishments work up from the lower group our engineering schools should provide education necessary for entrance into this group. Service in this group in competition with other college men and with the greater number who lack the advantage of higher education, but have the will to win, enables the engineering graduate to progress rapidly and to develop under observation of his chief. Contrary to the popular impression held by many young men, the positions in the upper groups are not attained by a short step from college but only through training in the groups at the bottom. Students and educators must realize that progress in this group requires sufficient time to get a proper insight into the methods of business, and the educators should co-operate with industrialists and aim to make the base groups adequate in every sense.

At present the demand for administrative talent is more pressing than for technical experts, but in the conditions of international competition now developing, research will be of the utmost importance. Success will lie in the improvement of technical processes, utilization of by-products, and reduction of waste as well as in better methods of production and distribution. The supervisory and administrative leaders in our industrial structure exceed the technical experts numerically, at least four to one, but no one should lose sight of the fact that both groups are essential and that in each there are positions of highest responsibility and honor.

The important thing is that the natural talent of each person be found and that the industrialists as well as the educators stimulate its development and use to the highest degree.

At the present time our engineering schools are turning out about 9,000 graduates per year, many of whom go into occupations outside of the manufacturing and

mechanical industries, so that it is difficult to tell how many act as replacements in the base group in these industries, but it is obvious that the number of replacements required and the number of new positions created annually constitute a demand far in excess of the number of graduates who desire such positions. Add to this the waste due to turnover of the personnel of the base group and to maladjustments and it constitutes a demand which, if it is to be supplied with proper material, will require improved methods of selection and training in schools and industries in order to cut down the time lost and the expense of getting men placed in their logical positions. This is a great educational problem.

The Educational Problem—In spite of the fact that many industrialists have concluded from their personal experience that the only effective industrial education is that obtained within the industry itself, the conference board believes that many more are coming to the realization that education in colleges and engineering schools and association with intelligent instructors and

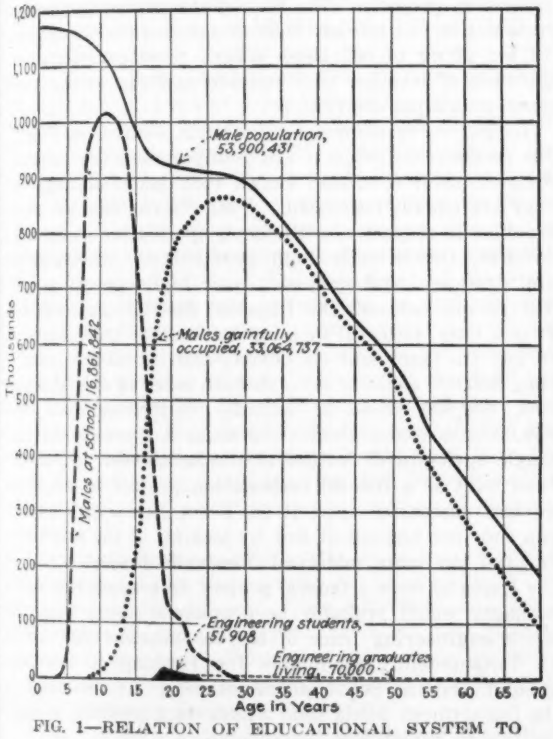

Male population, 53,900,431
Males gainfully occupied, 33,064,737
Males at school, 16,861,942
Engineering students, 51,908
Engineering graduates living, 70,000
Thousands
Age in Years
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
0 100 200 300 400 500 600 700 800 900 1,000 1,100 1,200

FIG. 1—RELATION OF EDUCATIONAL SYSTEM TO WORKING POPULATION

students exercise a strong influence upon the capacity of young men to advance rapidly to positions of responsibility. Fig. 1 represents graphically the relation of our educational system to the working population and to the total population of the country. It should be noted that the data in this figure pertain to males only, whereas the previous data included both males and females; also that the figures showing totals are represented by the areas between the curves and the base lines.

According to the best information available to the conference board, there are about 350,000 living male graduates of colleges and engineering schools and only a part of them are in industrial, financial and commercial occupations. The total number of engineering

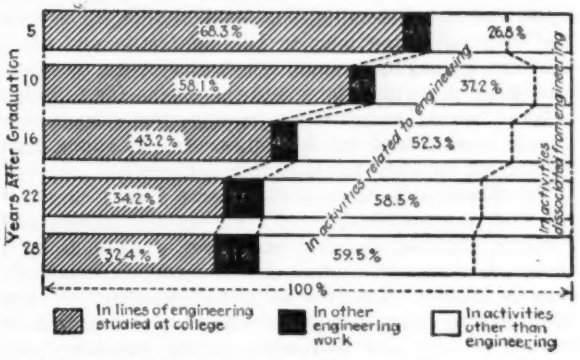


FIG. 2—CLASSIFICATION OF POSITIONS HELD BY ENGINEERING GRADUATES

graduates is about 70,000. The line representing these engineering graduates on Fig. 1 lies so close to the base line as to be hardly distinguishable, and the smallness of their proportion to the total gainfully occupied is apparent.

Since it is the boys and men between the ages of fifteen and twenty-five, both in schools and gainfully occupied, who come chiefly into the problem of correlation of industry and education, the problem requires the broadest survey of our educational system and its relation to the industrial situation. The phase of this problem which is naturally receiving most of the attention of the engineering schools, and which is the main consideration of the conference board's report, is illustrated as to numerical magnitude by the dark triangle at the bottom of Fig. 1, representing 51,908 students in the engineering courses of the colleges and technical schools in 1920. It is obvious that much depends on the method of selection and training applied to this group.

The Engineering School—Engineering education in the United States is now about 100 years old, and throughout this period of development the field of activity for engineering graduates has expanded continually and has shifted them more or less from the lines for which they were specifically prepared. This condition is well illustrated in Fig. 2. The figure is made up from a classification of the positions held by graduates from one of our engineering schools when they have been out of college from five to twenty-eight years. Graduates were classified in three main groups: (a) the men who are still in the field of engineering work studied in college; (b) the men doing engineering work in some other field than that studied; (c) the men who have shifted from strictly engineering work to executive or commercial activities. The latter group is subdivided by a dotted line to represent the number of those who went into activities totally dissociated from engineering.

One important question is as to how many of the shifts from engineering to non-technical pursuits have the nature of an advancement and how many were due to failure or a discovery that the graduate was better suited for some other activity. The report points out that after a swing toward greater specialization in undergraduate work in the engineering schools, there is now a general movement toward unification of courses. The colleges are now providing more and fuller courses in science, and the engineering schools by concentrating on the fundamentals rather than on technical training are following the traditions of the col-

leges, and it is becoming more evident that the schools are training young men to become fertile and exact thinkers, guided by common sense, who have a thorough knowledge of natural laws and the means for utilizing natural forces; and that the engineering schools now aim to produce not finished engineers but young men with great capacity for becoming engineers.

The National Industrial Conference Board summarizes the recommendations of sixty-eight industrial executives, thirteen railroad executives, four engineers, three educators, one editor, and six governmental officials as follows: That the method of selecting men for admission to colleges be improved; that the student be trained broadly and thoroughly in the fundamentals; that the colleges do more to stimulate initiative; that the instructors in technical subjects have more practical experience, and be selected for vision and high ideals; that the students be given practical training in industrial establishments either (a) by serving an apprenticeship before entering college, or (b) by industrial work during vacation, or (c) by supplementary industrial training after completing the theoretical course, or (d) by practical training in industry incidental with theoretical training in college.

The board calls attention to the fact that these recommendations apply broadly to the preparation for all branches of industry and that the industrialists are more interested in the general character and ability of their recruits than in the specific knowledge required in any particular industry. It also points out that while there is general agreement that engineering education should concentrate on fundamentals, there is a wide variation in the interpretation of "fundamentals."

The board emphasizes the fact that, although there is room in industry for more graduates than the engineering schools are now turning out, it is more important that a greater proportion of these young men be of high quality than that the total number be increased, and recommends that the requirements for admission should place a premium on intelligence, self-mastery, resourcefulness, courage, vision, open-mindedness, patience, resistance, critical judgment, integrity, and other elements of character as well as the knowledge pre-requisite to the college course.

Responsibility of Industry—The report points out that every industrial corporation of any considerable size must have a well thought out educational policy for the development of its interests, and that such a policy involves a measure of assistance to the engineering schools and colleges in the development of their courses of study and in providing opportunities for practical experience for the students. Such a policy involves adequate methods of training within the industry. As many engineering schools are rich in buildings and equipment but need help in improving the effectiveness of their teaching forces, industrialists can assist in finding and developing men for this service and can increase the esteem in which educators are held. They can also provide the opportunity for instructors to maintain contact with the industry and its needs and to become acquainted with the latest industrial methods and practices. They can also assist by devising ways and means of adequately testing the boys in preparatory schools and in making clear to the educators how young men with different types of mind and different kinds of training fit into the industrial order.

Through the Reclamation Country

By F. E. Schmitt

THIS is the seventh of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Calexico, Calif.

SEEING THE largest irrigation district in the country—the great Imperial Valley, which is hardly more than half farmed although nearly a quarter century old—brings forcibly to mind two common but erroneous assumptions, (1) that the federal reclamation projects are unsuccessful, and (2) that this is due to their having been handled less efficiently than other irrigation projects. The fact of the matter is that the reclamation projects are fully as successful as the others. (I am going to call these others private projects, regardless of whether they operate as corporations or as quasi-municipal districts.)

Irrigation development takes time. But even though the reclamation projects are younger than the Imperial district, their condition shows that taken all together they are equally successful. This district has the same troubles in respect to settlement, speculative ownership, failures, insufficiently high productivity, waterlogging and drainage, and complaint over high operating cost. Yet no one can call the Imperial district unsuccessful. It is a busy, peaceful farming community that manages to pay its taxes and its bonds; and its 55,000 population, 800,000 acres of area on both sides of the Mexican line, 500,000 acres of actually cultivated area and $50,000,000 annual production make it the most notable single agricultural feature of the Southwest. If it had been built as a federal reclamation project it would be no less successful than it is, I am sure—and anyone can convince himself of this by looking at the much less favored but more maligned Newlands project. But if the Imperial were a federal project its present engineer-manager would probably be denounced along with the whole engineering force of the Reclamation Service as an incompetent, responsible for running it into the ground, and the politician momentarily at the head of the Department would send a lame-duck product of state politics to direct him.

An Interview With J. C. Wheelon—That private irrigation projects are subject to almost precisely the same conditions as the federal projects was made very clear in an instructive interview given me a couple of weeks ago by John C. Wheelon, the veteran engineer who is general manager of the Twin Falls Canal Co., the operating organization of the South Side Twin Falls district in Idaho (noted among all northern projects as a prominent success). Mr. Wheelon said:

"We have just as many worries here as they do on the reclamation projects. Our people are the same kind as theirs, and settlers come to our project without any money just as they do to the reclamation projects.

"We started out with the idea of getting the successful renter, the man who wanted to become independent.

Under this plan settlement was so slow that we moved the line of our main canal downhill from one to four miles. But soon afterward the plan of settlement was changed, selection of settlers being eliminated; then the project settled up so fast that we built an upper canal on the original location in addition, a big increase in investment.

"The men that came were chiefly the failures elsewhere, middle-aged men, men who were fighting in the last ditch. We had the same experience in the Bear River valley; that project, now nearly thirty years old, is not yet out of debt, just getting on its feet. There as well as here it took three crops of settlers to make the project a success. It's not much different elsewhere, regardless of irrigation or natural supply of water; they say that in Kansas it took ten years to raise the first crop of corn, and sixty years to make it the garden spot of America, and Kansas isn't out of debt yet.

"Not all of our original settlers are here, by a good deal. Among those who are still here, there are some who came with capital to start in—as for instance, one family that came with $10,000—and have lost it all and may soon have to walk out. Others came broke and made a success. But not all that have left the project were failures; some Illinois men came here who were good farmers there and became good farmers here, and later on they sold out at a good profit.

"Our irrigation system cost about $26 to $27 per acre to build; we charged $26, a figure fixed in the beginning when we thought it would be ample to cover the cost. Our losses were made up on townsite lands, however. The low cost of the project is due to the remarkably favorable topography and to the ingenuity of the layout, which took full advantage of the topography. No drainage cost is included, as drainage was not done by the land company but is being carried out by the operating company in conjunction with the land owner, on a division of work which puts about 90 per cent of the cost on the company and 10 per cent on the farmer. But, despite the low cost, if this had been a government project there would have been the same amount of complaint howling that the reclamation projects get. Little politicians are the bane of reclamation.

"Irrigation farming looks pretty when you're traveling through it; but when you've got to live with it, for thirty years, it's different. The difficulties and hardships show up more strongly. It is not the same as farming in the East. When you come on to irrigation you find that it takes a better mechanic, a higher-class farmer, to handle the work successfully.

"That is why a weeding-out process is inevitable. Proper leveling of the land before the settlers came, or leveling and cultivating, might eliminate one of the three crops of settlers. But if 90 per cent of those who go into any occupation make failures, how can you expect 100 per cent to succeed in fighting the battle of the sagebrush desert?"

Private Irrigation—It may be worth while in this connection to remind the Easterner, who is apt to think of reclamation as being the whole of Western irrigation, that something over 20,000,000 acres is irrigated, west of the Missouri River, and only one-tenth of this is federal reclamation. Reclamation is 21 years old, but modern irrigation in these western valleys goes back three times as far, not counting the prehistoric irrigation in the Southwest revealed by remains of ancient canal systems, perhaps built in very early Indian days. With respect to success, private irrigation has less authority than its age and size would suggest, for systematic procedure (other than simple group co-operation) began less than 40 years ago, with the famous Wright Act of California and the later Carey Act of Congress. Further, the financial side of irrigation has been in an unhappy tangle until quite recent years. It shows so consistent a record of failure that the blackest picture ever painted of federal reclamation would by comparison shine with the brightness of success. Disappointments and financial losses without number have proved that irrigation is a very dubious field for money-making enterprise.

Irrigation as an Investment—One man's statement of the case, "As an investment, irrigation is simply not in it," has been widely endorsed. Nevertheless, a generation ago, capitalists saw big profits in irrigation development, and a few bond houses thought there were opportunities for making money by selling irrigation bonds. One or two successes were made, but then the bond market gave out, land sales and settlement decreased, and the industry ran onto the rocks. These troubles of the promoters (and of investors in bonds, who lost most of their money) delayed the development of stable systems of operation, but do not affect present-day comparisons of private with federal projects. Thus, the Imperial district here is operating with complete success, though the California Development Co., which promoted it in the early days, went bankrupt; and the same is true of many wholly successful irrigation districts not only in this state but throughout the West, where the records show case after case of a 20 to 80 per cent loss of the original bond investors through nonpayment or a scaling down of the bonds, though at the present time the operation of most of these districts is nearly as smooth and uneventful as the operation of a city water system.

Since irrigation conditions necessarily differ much, comparisons can be made to show almost anything. But closely adjoining projects are usually fairly comparable. Such a case can be found at the North Platte reclamation project, near Mitchell, Neb., where the federal project covers the upper part of the valley slopes and has a rather costly reservoir and canal system, while the lower slopes are occupied by private ditch systems much cheaper and simpler to build. Other cases occur in the Uncompahgre River valley, near Montrose, and in the Colorado River valley near Grand Junction, Colo. (Grand Valley project); and it may be noted that in the latter instance one of the private projects is rated as the most successful irrigation district in the state. Equally good comparisons can be made in the Snake River valley in Idaho, where alongside the federal Minidoka project there is much private irrigation, including the South Side Twin Falls project.

Reclamation Successful—Facts and figures in cases of this kind show clearly that: (1) federal projects compare favorably with private projects in first cost; (2) federal projects have an ample and dependable water supply, while private projects are apt to have an inadequate supply; (3) federal projects are well planned and well built, usually much better than private projects; (4) if there is any difference in fairness and efficiency of operation and care of maintenance, it is in

favor of the federal projects; (5) the operating cost of federal projects is lower than that of private projects.

Summarized, these points mean emphatically that reclamation has been done remarkably well and that the Reclamation Service has made a thorough-going operating success.

This latter is in large part due to the engineer operators—the project managers and the engineering organization of which they form a part. But the headless talk that has been coming out of the Interior Department to the effect that engineers are not fit to operate irrigation districts is shown to be frivolous not only by the performance on the projects themselves, but also by such facts as that engineers manage the three most remarkable and probably also most successful districts in the country—the Imperial Valley in California, the South Side Twin Falls in Idaho, and the Salt River Valley in Arizona.

As to First Cost—The five points above stated give opportunity for any quantity of discussion and dispute. Without undertaking to prove them here, I want to cite one or two illustrative cases. A good comparison of first cost may be made on the North Platte project, where the Tri-State ditch, (owned by the Farmers Irrigation District, originally a corporation project) and the reclamation or Interstate ditch, much farther up the hillside, are parallel; the Tri-State ditch system, without storage and *without laterals*, cost $42.50 per acre, while the government ditch, with a much longer canal system, much more scattered land, and a costly storage reservoir, and lateral canals to each farm, cost $71 per acre. Similarly, the South Side Twin Falls project, with a remarkably favorable topography and layout, cost $27 per acre, without storage; the North Side Minidoka project, less favorably located, cost $42 per acre with storage, and this includes a considerable item for drainage, while at Twin Falls the drainage cost is being met out of operation charges.

Reclamation moneys were spent with exceptional efficiency and honesty, and the farmers' spokesmen who charge that the project costs are too high would learn much, if they cared to, by examining the costs of private projects in their neighborhood, including the cost of making up for premature decay or the short life of fantastic hillside flume systems—some of which the Reclamation Service has had to take over in order to save the farmers from utter ruin even after the outside investors had given up their own investment. It has to be considered also that the low lands, of best quality and easy to irrigate, were taken up before the government came into the field, so that reclamation in most cases deals with the costly, uninviting and sometimes decidedly forbidding propositions, while private development always is concerned with inherently promising cases. Also, that reclamation in all cases is based on a supply assured by very costly dam work when necessary, while private development is usually content to take chances with a doubtful supply, in order to save cost. As to needlessly high-grade work, I had an engineer tell me that the Service made a mistake in building concrete-lined canals where clay lining would have done; but a water users' manager complained to me that the Service had not built well enough, so that the district now is "practically reconstructing the whole system," an absurd exaggeration of normal maintenance needs which is valuable only as neutralizing the statement just preceding.

Operating Costs—Operating costs are the reclamation farmer's special bugbear. He says they are too high and blames this fact on the high overhead of the Service. "We have to support those offices in Denver and Washington." The facts are against the farmer.

He gets cheaper service in operation and maintenance than the private-project farmer. To take a case: the Grand Valley project, in Colorado, has an operation and maintenance (O & M) charge of $0.75 per acre-foot or for 3 acre-ft. per season a total of $2.25 per acre. The much cheaper private development on the lower valley slopes, the Grand Valley Irrigation Co., has an annual O & M charge of about $1 per acre; but this system operates only the main canals, which is less than half the total O & M cost. The Palisade Irrigation District, close by, has an O & M charge of $1.75 to $2 per acre (leaving out interest and sinking fund). Three other districts adjoining (Mesa County, Orchard Mesa and East Palisade) have charges respectively of $3.20 to $4.80, $6 to $8.50, and $18 to $27, the latter case being a very small district (646 acres total) and having heavy replacements to make out of its operating income. Similar comparisons, each qualified by taking note of many special conditions, can be made anywhere; and even a comparison of reclamation costs with exceptionally low private costs, as Minidoka and Twin Falls (North Side Minidoka, gravity supply, operated by water users, $1.90 per acre; South Side Minidoka, high-lift pumping supply, operated by government, $1.95; North Side Twin Falls, private, $1.10; South Side Twin Falls, private, $1.12 for O & M excluding drainage or interest) strengthens rather than weakens the comparison. To make the case still more definite, the alleged high overhead of the Reclamation Service is in fact a lower percentage than that of private operation.

One further point may be made in favor of the success of the Reclamation Service work. An active antagonist of the Service, a water users' official who has declared himself an enemy of engineer operation of the Service and who is pretty constantly engaged in guerrilla warfare with it, in writing to another water users' official who had asked for advice gives the following pretty testimonial to the Service: "I do not know of any organization more competent to construct drainage and flood protection works than the Reclamation Service. . . . Our experience is that it is able to do construction drainage work far cheaper than private contract; we have tested the matter very carefully. . . . I have never heard of any graft or charges of graft. In my personal opinion the Service is the most efficiently conducted department of our government, as well as the most economical." These remarks were written prior to Secretary Work's entrance upon the scene.

Second Trent River Lock Completed

The second of the four locks being built to improve the Trent River in England has been completed at Stoke Bardolph. The plant is to render the Trent navigable the year around for large type barges as far as Nottingham. The first lock is at Holme Pierrepont. It was completed a year ago. The other locks are at Gunthorpe and Hazelford, and work is well advanced.

Federal Land Reclamation: A National Problem

4. Twenty Years of Reclamation

The Fourth of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

By F. H. NEWELL
Formerly Director, U. S. Reclamation Service

TWO DECADES in the life of a nation are relatively short, yet these last two decades have been so crowded with experiments in governmental ownership and operation of public utilities of various kinds that they afford illustrations of the trend of governmental affairs greater than during the preceding century. To students of political and social science there are perhaps no more interesting examples of the strength and weakness of government ownership than are afforded by the history of the Reclamation Service since its inception in 1902 to its conclusion as a Service in 1923. Advocates or opponents of governmental interference in local affairs find many excellent illustrations of good or bad conditions. On the whole it must be admitted that whatever theory may be urged, the material results are highly commendable and reflect credit upon the men who initiated this work and placed it upon a high plane physically and morally.

During the twenty-one years of existence there have been created, as stated in a previous article, opportunities for 33,000 self-supporting small homes, affording a livelihood for at least 150,000 people. The gross crop production has been $50,000,000 per year and over. The homes thus created have a value to the community and to the nation out of proportion to their mere number because these are located in what were previously barren wastes, now converted into highly productive oases. By their presence they make possible a development of many industries which could not otherwise have existed and they have raised the general standard of comfort and prosperity of the more sparsely settled states.

In all these undertakings under the Reclamation Service, perhaps the most interesting are those which have had to do with the human factors as contrasted with the purely physical. These include the influence or effect of the work on social institutions, and upon the opinions of men regarding governmental affairs. In one sense, the work of the Reclamation Service has been a practical exemplification of state socialism in that the government has used its own funds and employed its own servants to build works for the benefit of its citizens and has operated these works for many years at its own expense, losing the interest on the investment.

The men who advocated and organized the Reclamation Service believed implicity that it was practicable to conduct work of this kind under a government organization and with an efficiency comparable to that of a well organized corporation. They did demonstrate this fact. The outcome shows that with a nearly ideal organization and with a high degree of efficiency it has been possible to achieve nearly ideal results wherever the mass of the people concerned have been endowed with the ideal degree of energy and ability. In proportion, however, as the land owners under the reclamation projects have been lacking in ability, strength, experience, good health and other essential qualifications, to that degree the results have fallen below the standards set.

As previously stated, wherever good farmers have chosen good land under the reclamation projects, and have practiced a good system of farming adapted to the climate and markets, there the results have been such as have justified the most optimistic statements. Where, however, the inexperienced or poor farmer has been unsuited to his method of farming and so handled the land and water that the soil has deteriorated in productivity, and especially where he has become discouraged and moved to town, renting his land to itinerant tenants, there the results are disappointing and can be pointed to as showing the ineffectiveness of governmental control.

Comparison with Private Irrigation

It is to be noted that the work by the government in reclaiming lands introduced few novel features other than those which grew out of the fact that the operations were conducted by government officials, working under the limitations imposed by a century of accumulated rules and regulations. There had already been built works bringing water to over ten million acres of land at the time the reclamation act went into effect. Most of these earlier works were extremely simple because the easier enterprises were naturally taken up first. There remained for the government the more difficult—in fact, it may be said that in 1902 investors had come to learn through bitter experience that the building of reclamation works, especially those involving water storage and the settlement of the land, could not be made a matter of profit.

By 1900 all the larger private or corporate irrigation enterprises, with hardly an exception, had gone into bankruptcy or had been reorganized with almost complete loss of the original investment. The strong argument for the government's taking up this important work was that, under private or corporate auspices, it had not been and could not be put upon the basis of earning 6 per cent interest on the investment, much less of obtaining a profit. Thus land reclamation and settlement in the West was practically at a standstill and it looked as though the West would remain largely undeveloped unless some way was found of inducing the government to assume the load and to lose the interest on the investment. It was argued that such loss would be made up, or more than compensated for, by the indirect gains which necessarily come to the community, to the state, and to the government itself through the creation of homes on the land.

The assertion is made that the government, that the whole body of taxpayers, can well afford to lose the interest on its investment for at least 10 years, or,

to put it in another way, can afford to give this as a bonus or subsidy to the land owners under the projects as compensation in part to them of the hardships and uncertainties of pioneering.

In the matter of the original investment in reclamation works and in their economical construction, there is little but commendation to be given. This much can be claimed for governmental ownership, that in expenditure of funds for construction it is possible for the employees of the government to reach and maintain a high degree of efficiency. When, however, we turn to the other side, that of operation and maintenance, a different story may be told. Here it is not a question of expenditure of moneys to secure a certain definite result, planned out in advance; the large and crucial factor is not the economy of use of materials and forces but it is the effectiveness of dealing with large numbers of persons, individually and collectively, in matters pertaining to their most intimate personal affairs. Here governmental methods have not yet been developed to a point where it can be claimed that a degree of efficiency can be secured at all comparable to that of private control. Here is where the government official is seriously handicapped. He cannot exercise the same discretion in dealing with voters that he can when, as an employee of a corporation, he is doing business with individuals. Here is what at present seems to be the insuperable obstacle to success in governmental operation, and here is where the reclamation laws should be so amended as to require that the reclamation works, when built, shall be put under the control, at the earliest practicable date, of responsible well organized land owners of the community whose existence depends upon the maintenance and operation of these for all time to come.

Problems of Reclamation Service

Legislative Difficulties—While there has been a progressive improvement or evolution in economy and efficiency in engineering and industrial or business details, there has been under congressional control a lack of forethought, a failure to meet future needs, that tends to frustrate the object of the law. In each recent Congress, engrossed in other matters, a few interested men have struggled, against the general indifference, to secure certain personally important objects, often incongruous with the making of homes on the land. On no one leader has fallen the mantle of the late Senator Newlands; none has voiced his inspirations toward achievements of country-wide benefit.

The most conspicuous of these activities urged before Congress have had to do not with the carrying out of the larger objects of the original reclamation act in home-making, but more with the attempts to secure minor adjustments to meet the demands of individuals or groups of land owners who have not been able to utilize their lands in such way as to produce average results in the way of crops. Under private projects the owners or managers necessarily possess full power and authority to deal with such individual land owners who are found to be unfortunate or are unqualified as farmers. Of necessity they must make individual exceptions and adjustments, helping one man to let go and stimulating or encouraging another man in accordance with his individual capacities. The agent of the government, however, cannot exercise anything like the same degree of discretion, even though he may be better qualified to do so. He must treat all alike and must endeavor to carry out the requirements of law whether these are applicable or not. What really results is that the ultimate decision by the "powers that be" is that in order not to oppress any one citizen, all others who might make payments or comply with general conditions are excused from so doing.

Thus, due to the attempt to meet individual difficulties, there have been passed in succession a number of general relief acts, the most notable of which extends the time of payment of the capital investment from ten years without interest to twenty years without interest. Now the proposition is still further to extend this time to forty years, also without interest. No community or no country has ever granted conditions as liberal as these nor has imposed upon other taxpayers the corresponding burden in the way of subsidy granted indirectly to land owners under reclamation projects. This bonus or subsidy given by Congress and levied upon the general taxpayers has been estimated at about $6,000,000 per year. This is figured on the assumption that for reclamation purposes $140,000,000 has been kept out of the treasury. An equivalent amount is being borrowed for purposes of the government on which 4½ per cent is being paid. Many taxpayers are beginning to ask whether this is fair in consideration of the fact that whenever land owners, other than those on reclamation projects, secure any loan directly or indirectly from the government, such as through the federal farm loan banks, they are required to pay 5½ per cent interest plus 1 per cent amortization. They are asking why the landowners on reclamation projects, who claim a larger average crop production than other parts of the country, should be thus favored.

Imperfect Policies—Congressional control, or perhaps more properly, lack of a definite policy established by Congress, has led to the taking up of an infinite number of minor details which might better be left to local enterprise. It has already been pointed out that the proponents of the act did not contemplate applying it to the smaller distributaries or to the tens of thousands of small structures which, on private projects, up to that time had been left to the individual land owners. Neither has Congress expressly authorized or forbidden the leveling of the land and getting the farm into such condition that the newcomer might get to work to produce a crop.

There are still two distinct schools of thought in reclamation and settlement policies: one, the older, contends that the best results will ultimately be attained if the government confines its efforts to building the larger structures, such as can not be built by private enterprise and leaves to the individuals, or rather to the community or to the state, all of the matters of roads, distributing systems, leveling the ground, and getting ready for immediate cultivation of the land. The advocates of the other course point out the self-evident fact that the quicker the pioneer can get his farm into good condition the better for him and for the community at large. This is true if he is qualified to utilize these advantages, but if not then there is a question as to whether the hard struggle of the pioneers in developing a farm, each man for himself, is not an essential prerequisite to success through the early elimination of the unfit. Much can be said on both sides of the question and usually the

manager of the reclamation project, where most has been done to facilitate settlement, believes that the other course would have been better and vice versa. Neither is satisfied with the actual results.

The reasons for success or failure lie not so much in climate, soil, or markets, but rather in the character of the landowner, his experience, strength, health, and especially the "will to win," or possession of qualities which distinguish the pioneer. Unfortunately, the law does not permit any selection of the men, and their families, who are to enjoy the bounty of the government. The theory of the law is that the old rule is to be followed, "first come, first served." It makes no difference whether the applicant is young or old, strong or weak, single, married, or widowed, a hopeless invalid, or a giant in strength, he or she is allowed to take the land, if available. In the case of two or more applicants for the same farm the matter is determined by lot and not by any question of merit or ability other than that ex-service men and their widows are given a preference.

Results of this Method—Results of this haphazard method have been the same as if the army or an industrial organization should be recruited in the same way. The strong husky laborer might get a place as copyist and the weak, frail widow the job of furnaceman, the officers being selected by lottery. The process of elimination which must follow any such course has been heartbreaking and has tried the nerves of every one connected with the Reclamation Service. Each governmental employee has felt a certain personal responsibility in these matters. If he were free to exercise his judgment and to act as could the employee of a private concern, he might greatly help or at least he could prevent many of these people from getting into difficulty, but as an employee of the government he must of necessity stand by, report conditions, and wait for instructions.

The worst results, as above noted, have come not from physical conditions of soil, climate or markets, but from the lack of adaptability of the land owner and especially of his family to the peculiar conditions on each piece of land. The good farmer, the man of experience, on coming to a project, has not been willing to spend his time or money on land of inferior grade. The inexperienced man coming perhaps from the city, and knowing nothing regarding soil, has seized upon every available acre, has importuned the man in charge to include lands obviously unfit, and because of his inexperience has not been able to bring these lands up to a high degree of fertility, but on the contrary has allowed them to deteriorate.

It should not be inferred, however, that it is possible in advance to judge unerringly of the value of soils and of the effect of water upon the soil. It is only within a few years that the notable work of Carl S. Scofield and others has begun to reveal some of these mysteries of soil becoming "worn out." He has shown that as a broad generalization, "soft waters make land hard, and hard waters make land soft" or tillable. He has also brought out more strongly than was before assumed, that while in most cases excessive use of water is injurious, in some cases it is absolutely necessary in order to wash out the accumulated salts. It is not proper to attribute any blame or want of judgment either to government officials or to the settlers in many of the cases where lands have deteriorated or become less productive.

The error which has prevailed through all private enterprises and has affected government work as well, was that of assuming that the large areas of reclaimed land could and would be settled upon immediately. Experience has shown that an agricultural community, like a tree, cannot spring into full bearing at once. Years of slow growth are essential; especially where there has been no selection of the settlers there must be a rapid turnover. Many families must come and go before there is a fairly complete adaptation to local surroundings.

Taking the United States as a whole, including new and old farming localities, there has been a turnover during the last year of 6 per cent in farm ownership and 27 per cent in tenancy. If the reclamation projects were on the same average with that for the rest of the country, there should have been a complete change in ownership during the past sixteen years. This normal change in part has been retarded by the well meaning attempt on the part of Congress and of the executives to induce the early settlers to remain by granting easier and easier terms of payment. As a matter of fact, as shown by experience on similar private enterprises, it is a matter not only of good business but of fair dealing to enable the rapid turnover in land ownership which ultimately results in getting people who are better qualified farmers.

These imperfections or errors have resulted in a stimulation of speculation. This in turn has been followed by tenancy and the accompanying evil of soil deterioration. Speculation has been promoted by the easy terms of payment. Many a man controlling a piece of land given away on condition of settlement and furnished with water at cost at government expense, and without interest payment, has preferred to hold on to this piece of land. Perhaps his wife has a similar farm; also his son and daughter. He may thus in the name of others control several farm units. He prefers to move to town and try to rent these and gain a profit through the increase in land prices. Some have succeeded. The majority have failed. The blame, if any there be, is not that of the management, but rather of the well-intentioned members of Congress who have urged more and more lenient terms in the law regarding repayment of debts owed to the government.

Irrigation Troubles—When the government went into the business of reclamation of lands by irrigation, there was little in the way of accurate facts recorded regarding irrigation methods. It was only after the government had embarked upon this enterprise that the experts of the Department of Agriculture began to give out the results of their observations. The owners and operators of private projects were unwilling to admit the existence of certain difficulties, believing that these were local in character, but as time went on and they became better acquainted with the difficulties, more and more these were brought to the front, especially as the methods of remedying the troubles became apparent. For example, the swamping of areas under irrigation was known, but the explanation generally given was that gross carelessness had been used; careful observation demonstrated that even with the most economical handling of water there has

been some swamping of cultivated fields, requiring the construction of drains, and that thousands of acres have deteriorated, usually with the appearance of alkali on the surface, but occasionally without any apparent cause.

Enough was known about the necessity of drainage to justify the preparation of plans for drains from the very outset of governmental reclamation. Some of the main line drains were built, others were projected with the thought that the land owners would build these at their own expense, as the need developed through the complete settling up of the country. Experience showed, however, that it is not possible in advance to lay out an economical drainage system because it is impossible to ascertain the texture of the underlying soils or to predict with any considerable degree of success what effect the percolating waters will have on this complicated texture. Thus drains built in advance of irrigation sometimes have been found to be wholly ineffective. In other places, where the underground sands or gravels seemed to indicate that drainage would never be required there, it has been necessary after a few years to construct large drainage works. Many of these matters are covered, as above stated, in the review of the subject by Scofield.

Observation also has changed somewhat radically the conceptions as regards the so-called duty of water, that is the amount of water required to furnish adequate moisture to a given area. Popularly it is assumed that a cubic foot of water flowing continuously throughout the irrigation season will furnish adequate water for one hundred acres. In other words the water duty is expressed as one hundred. A more accurate way of setting the duty is in terms of the total amount of water applied to the land, that is, thirty inches in depth during the irrigation season. For many years the remedy suggested for every evil was to increase the duty, that is, to increase the number of acres which could be irrigated with a given quantity of water, but, as above stated, scientific research has shown that this is not always a safe rule.

Political Management and Land Speculation—During the first decade, following 1902, the control of affairs was under men who drew up the reclamation act and fought for it, who had the vision of service. Then came new men, who had not argued for these great objectives, who viewed the law simply as an established fact, as an opportunity to stimulate local business immediately by spending federal funds, in contrast with the original ideals of future permanent benefits. There was a reaction from idealism to so-called practical considerations. Liberal concessions were made to the speculative interests, to the lawyers, merchants, tradesmen, or mechanics, who had acquired one or more pieces of government reclaimed land, ostensibly for a future home, but more directly in the hope of selling at a profit. These landowners, living in town, rented their farms. Tenancy rapidly increased, accompanied by "mining" the soil and crop decline. Speculation in land, the desire to capitalize the future, to get the unearned increment of value, is a strong temptation to all citizens. The speculative element is made up of wide-awake men, keen in local affairs, usually more active than the man out on a farm, who is busy with crops and livestock.

It is true that the *bona fide* homemaker does complain that the non-resident land owner is favored, that itinerant tenants are not desirable neighbors, that the neglected fields—of the speculative owners—are infected with plant and insect pests, that roads and schools cannot be kept up—but his voice is relatively feeble. The fact that the "town farmer" has greater influence in getting more favorable terms of payment, still further increases the speculative tendency. In short, it is the relatively well organized minority, the men who have the time and inclination for discussion and letter writing, who make the greatest impression on the law-makers.

The attitude of the states in which the federal reclamation projects have been built has been rather favorable to speculation. The state lands, within the projects, in many instances have been held out of use for years and at prices which are so high that purchasers are wary. The conditions of sale of state lands have been such as to further speculative holdings instead of enforcing the requirement of actual cultivation and settlement. The highest result in land reclamation and settlement can be attained only when the public demands that state officials co-operate fully in these matters and maintain a higher ideal of the use of the state lands in making homes as contrasted with making money.

Borrowing by Farmers—The greatest difficulty in connection with the successful operation of any reclamation project, private or public, is that connected with the financing of the farmers. Most of these take up a new farm on cheap land largely because they do not have adequate capital to get a start elsewhere. Few have enough capital or credit to successfully handle even a small irrigated tract. Many would-be-farmers forget that farming is a capitalistic enterprise and that a certain amount of equipment is needed even by the tenant farmer. The owner must invest a large amount of money directly or indirectly in securing a shelter for his family and for his animals and in procuring the tools, seed, and other essentials.

The federal government does not lend money directly to these pioneers nor has the state done so except in a few instances. Most of the money or credit needed must be had from relatives, friends, or from local banks. The interest charge in these new communities is high, rarely if ever less than 8 per cent, more often 10 per cent or even 12, when commissions are added. This makes a load which it is almost impossible for the pioneer to carry unless he has some money of his own or is prepared to endure privations or even hardships.

It is true that the government indirectly furnishes some credit in that it has in effect loaned a considerable amount of money to the land owner, with no interest; that is to say, it has invested say $60 per acre in his eighty-acre farm or $4,800, without interest. The possession of this farm on which he may have paid nothing enables the owner to borrow considerable amounts of money, but on this he must pay a heavy rate of interest.

On top of this heavy interest charge are the large taxes which have been incurred in every new community for roads, school houses, bridges, county buildings, and all the improvements equaling or exceeding those of old communities in the east. The pioneers are trying to do in ten years what their forefathers did in a hundred and are correspondingly loaded with debt

such as can be paid only by exceptional crop conditions.

Landlordism—The ultimate object of the Reclamation Act, being the production of small self-producing farm homes, it is obvious that its success must be measured by the number of these contented homes rather than by great works, no matter how economically or effectively these have been built. The most important item then in any review of twenty years of reclamation is that relating to the number and proportion of successful homemakers.

Taking all of the farm units which have been irrigated or furnished with water by the use of the reclamation fund, it appears (Fig. 1) that 73 per cent may be classed as successful; that is, the family of the owner apparently has been supported by the products from the soil, which without irrigation (effected by the government works) would have been prac-

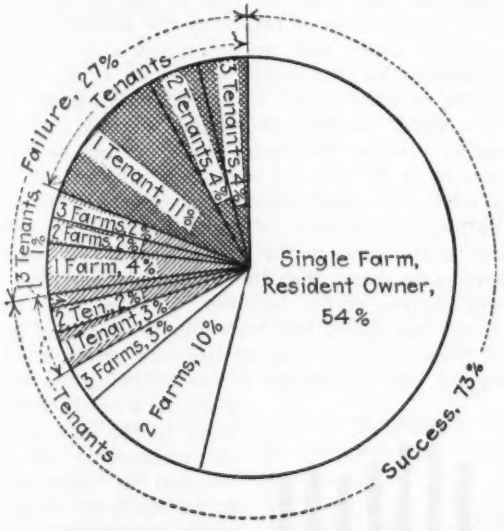


FIG. 1—PROPORTION OF LAND OWNERS HOLDING ONE OR MORE GOVERNMENT-RECLAIMED FARMS, AND THEIR SUCCESS OR FAILURE

tically valueless. The remaining 27 per cent, many in the hands of non-resident owners, must be considered as unsuccessful at present. Many of the latter can be converted into successes, however, by proper administrative control, except in cases where the lands have already been ruined by bad management.

Under existing conditions, it is somewhat remarkable that so many have succeeded on the land, but there has been a vast amount of unnecessary hardship, suffering and loss, because as previously stated there has been no way to prevent the unqualified homestead entryman or woman or purchaser of these lands from deceiving themselves or being deceived regarding the difficulty of pioneering.

The accompanying diagram (Fig. 1) illustrates the proportion of successful and unsuccessful landowners on the reclamation projects. The greater number of these, 54 per cent, include persons who have observed the spirit of the reclamation act, who have confined their efforts to a single farm unit and have lived upon this and cultivated it.

A considerable number of the land owners have not been satisfied with a single farm, which in the opinion of the Secretary of the Interior was adequate for the support of a family, but have acquired two farms, or sometimes three or more, the intent of the law being evaded by holding these in the name of the wife, child, or other relative.

These owners of two farms, who are rated as successful, comprise 10 per cent of the total, and those holding three or more farms, which they are cultivating themselves, comprise three per cent.

Of the unsuccessful landowners, the greater part, 11 per cent of all farms, are the people who are not living on their single farm, but are renting it. Other unsuccessful owners have two, three, or more farms, the rent from which, however, is not adequate to pay the interest, taxes, and other dues, and yield an income adequate for their support.

The reasons for the spread of landlordism are by no means simple, most of them arising from the easy terms of repayment and consequent inflation of land prices. Other causes lie in the fact that many of the people who have acquired lands under reclamation projects have found the inconvenience of country life too severe. They desire to live in town on account of the schools or of the conditions of employment of one or another member of the family. They find that the "lure of the white lights" is too much for the younger members or the earnings in industry are greater than those from the farm. It is perfectly proper that they should move to town but the point is made that the government has practically loaned the money, invested in reclamation, to the land owner for the purpose of enabling him to secure a home on the land; if he does not wish to live in this home, then in fairness he should permit some other owner to have possession rather than hold the land out of use or as a source of income through rents derived from a tenant or from the labor of a hired man.

Conditions Affecting Success of Reclamation

Degrees of Productivity—One of the alarming conditions on the reclamation projects has been the tendency toward decrease of productivity commonly known as the "wearing out" of the soil. When the reclamation act was passed, it was known that wherever irrigation was being practiced on any considerable scale, there was a tendency to swamp some of the lower land, also for the earthy salts, known as "alkali," to develop on or near the surface, ruining the cultivated field. In a well irrigated country, as for example, near Salt Lake City, Utah, it was estimated that from 15 to 20 per cent of the land, productive in the earlier years of irrigation would ultimately thus be injured. It was assumed, however, that on government projects, with the greater skill used in the works and in their operation, and better economy of water, these land losses would be greatly reduced.

The investigations by Carl Scofield, which were described in a previous article, are casting a light on this somewhat obscure subject of soil deterioration. Its effects are all too plainly visible in decreased productivity, as illustrated by the accompanying figure (Fig. 3) which shows the reduced yields of alfalfa hay, seed, and cotton. Here is a case where economy of water has been carried to an excess. Apparently, a far larger amount must be put upon the land to wash out the alkali which is accumulating. Similar conditions have been noted in Salt River Valley where lands which have been producing heavily in cotton were said to be "worn out." As a matter of fact, analysis showed

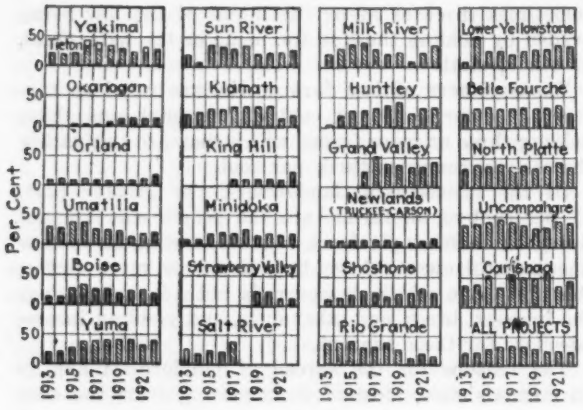


FIG. 2—FINANCING—PERCENTAGE OF TENANTS 1913 TO 1922 ON U. S. RECLAMATION PROJECTS

that the application of two acre-feet of water per acre, as has been the custom, tended to leave the salts in the soil. To wash it out and restore conditions of tilth would require at least two acre-feet additional with a corresponding doubling of the cost of the water.

Transportation and Marketing—When the lands on the government reclamation projects were first irrigated, there was usually a considerable demand in the immediate neighborhood for the alfalfa and other crops which were then produced. This was because contractors were still working in the vicinity and many persons were erecting buildings in the new towns and utilizing considerable numbers of men and of animals. The amounts received for the crops produced was notably large, being determined by the price in the outside markets, plus the cost of freight. In a few years, however, the conditions were completely changed.

With the development of larger areas of irrigated lands there were produced greater quantities of food and forage than could be disposed of locally, especially after the contractors and builders had left the vicinity. Then the prices suddenly dropped to those in outside markets, minus the cost of freight to these outside markets.

Every acre of the irrigated land has been or should be put into alfalfa or some other clover at one time or another in order to aid in the development of nitrifying organisms in the soil. To picture the desirable condition it is as though a crop of alfalfa was spread down and then rolled up as the fields after a few years are plowed and put into cultivated crops. Many of the land owners, however, having once put their land into alfalfa, prefer to let this crop remain and are unable or unwilling to practice the systematic crop rotation necessary to maintain or increase the soil fertility. They must find a market for the alfalfa hay in the immediate vicinity or else ship it to distant points. The local market is quickly glutted and there has resulted the economically unstable condition where hay is being shipped off the project and butter and pork shipped in. It is or should be obvious that no group of farmers can be permanently prosperous where this condition exists.

The experts in marketing of the U. S. Department of Agriculture have studied the situation and have given excellent advice, all which may be summed up in the recommendation that the heavy products such as hay and grain be manufactured on the farm or in the immediate vicinity into the more condensed form such as beef, pork, mutton, poultry, eggs and butter fat, retaining the fertility on the farms and shipping out only these condensed products—in other words, following the mottoes of "Feed the family from the farm and feed it first"; also "Feed all you raise and raise all you feed." Like other simple and obvious rules, this is not always easily followed, the advice has not been particularly palatable to men who have been accustomed to the one crop method. The location of the reclamation projects, however, remote as they are from large marketing centers, requires for ultimate continuous prosperity that some such method be adopted.

Have Settlers Had Adequate Help?—The question is frequently asked as to whether the government, state and national, has done all that it can or should to facilitate the creation of homes on the reclaimed lands. Many people assert that too much has been done and that communities as a whole would now be far better off if less of what might be called "paternalism" had been displayed. On the other hand, there is a steadily increasing demand that more and more aid be given, not merely in the way of sound agricultural and economic advice by county agents and experts of the state and national Department of Agriculture, but by going further, particularly in the way of credit facilities.

There is no doubt that the pioneer farmer must be afforded certain credit facilities. At the same time experience has shown that unfortunate conditions have arisen from the obtaining of too easy credit, notably during the time of inflated prices following the world war. As a result of these, many of the land owners on reclamation projects invested in other lands, in oil stock or in equipment such as automobiles which they really did not need. In short, taking the projects as a whole, there has been perhaps not too much credit but frequently an unwise use of the credit which was available. This is to be expected because many of the settlers upon the reclaimed lands were people who, through lack of thrift or "bad luck," have been induced to leave their former homes and who, with characteristic optimism, plunged into new enterprises to the full extent to which they could secure credit.

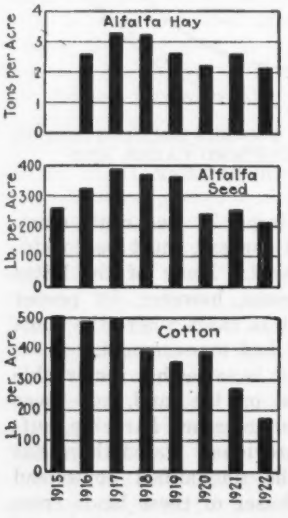


FIG. 3—PRODUCTION PER ACRE PER YEAR ON YUMA PROJECT

Showing the effect of accumulation of alkaline salts in the soil in reducing the yield per acre.

No help has been given directly by federal agencies in this matter of financing or credit other than that above described which arose indirectly out of the fact that the land owner was able to obtain possession of a tract on which the government had expended several thousand dollars and on which he was not paying any interest. This gave him certain opportunities for bor-

rowing other sums, on what is sometimes considered a second mortgage at high rates of interest.

In the matter of aid and advice, however, the national government, in co-operation with state authorities, has been liberal, responding to every inquiry and sending out printed matter not only in the form of pamphlets but also in a series of short statements used by the local press. Special appropriations have been made for investigations and for experimental farms on government projects. In round numbers, over a million dollars has thus been expended producing results of great value such, for example, as those which led to the planting of the long staple Egyptian cotton in the Salt River Valley, from which millions of dollars in profits have been received.

This work of experimentation and demonstration is necessarily slow; it requires great patience and persistence because the building up of better methods of agriculture or the spread of correct information regarding crop rotation and marketing necessitates man-to-man contact continued through months or years. The same is true of dairying, which has been notably successful on several of the projects, for example, on the Newlands in Nevada. This success is due to the quiet persistence of one or two men who have slowly overcome prejudice and various obstacles of human origin, finally getting the farmers to realize the true value of a good system of dairying.

The problem everywhere is to induce the farmer on the newly irrigated land to forget much of his former experience and to adopt the methods which agricultural experts and experienced farmers in the vicinity have found to be most successful. The inertia is great, and where a man has been accustomed to raising wheat only or alfalfa only and has an equipment for this purpose, finishing his entire work for the year in a relatively few weeks, he is unwilling to go into dairying, for instance, which requires daily attention throughout the entire year.

From what has been given in the preceding paragraphs, it must not be inferred that reclamation as a whole has not been a success. Rather, the contrary. Human interest is attracted, not by the rather prosaic statements of the successful enterprise, due to patient plodding and thrift, but by the unusual or extraordinary conditions of failure and the reasons for these. It is easier to draw a lesson from such failures than it is from the daily routine of a uniformly successful process.

The real measure of success as regards the reclamation work is measured, as before stated, by the predominance in numbers of prosperous and contented homes. The more convenient measuring stick is, however, that of the dollars which have come back from the investment made. While it is true that as yet not much more than 10 per cent of the original investment in the reclamation works has been returned to the federal treasury for use over again, yet this is not an indication of the breakdown of the theory but rather of the attitude of Congress in extending the time of payment. This was done under the belief that even if the money was not repaid at an early date the benefits through the development of homes and communities more than repaid the losses in interest on the investment.

Summing up the whole situation, it may be said, as in the beginning, that the law has been a success. It can be made a greater success in the future if the law makers and the executive officers will be able to apply the lessons taught and will have clearly in mind the object to be attained, namely, the creation of rural homes. Incidentally, it should be emphasized that when the reclamation act was passed, it was assumed that the greatest possible development of homes would be on the vacant public lands of the west. The studies made by the Reclamation Service in other parts of the United States, however, and published in 1919 (Development of Unused Lands, 66th Congress, 1st Session, House of Representatives, Document No. 262. Oct. 10, 1919. 184 pages) show that under present conditions the largest and best development of homes can probably be made on the unused lands of the South and East. The cost is far less than in the West because of the inflated land prices which have resulted in the West from over-exploitation of irrigable lands. The hope, therefore, of many public men is that the reclamation policy may be made truly national as contrasted with its present local or sectional character, and that under a revised law, based upon the experience of the past twenty years, larger and even more effective activities may be conducted throughout the United States wherever suitable unused lands exist as rapidly as needed for the creation of the small self-supporting farm homes, the backbone of our national and business institutions.

[*Further articles in the series will deal with past experiences and problems of reclamation and with future development. In next week's article George F. Kreutzer will discuss land settlement problems*—EDITOR.]

Reorganizing Austrian Railways

A LAW has recently been passed providing for the reorganization of the Austrian State Railways, in order to place them on a satisfactory economic basis, and for the creation of a corporation in Vienna for the purpose of conducting the operations of the federal railroads. This corporation must administer the entire property of the railways and act as a trustee for the government. The government is to furnish a capital of 200 milliard crowns, and is to cover any deficits.

An executive committee of five members will be held responsible to a commission of fourteen directors for actual operations. Eleven members of this commission are to be business men or experts in handling transportation problems, and are to be appointed by the railway government for a term of three years. Three members are to be chosen by the railway employees. The executive committee to be appointed by the commission and may be recalled by consent or order of the government. The chairman of the committee will have the title of general manager; each other member that of manager.

In addition to managing operations the executive committee must pass on all reorganization questions, formulate operating policies and plans, appoint and manage the personnel, and submit a financial balance sheet monthly and annually. It may raise short term interior loans of low denominations. The commission of directors is charged with general supervision and with safeguarding the public interests.

The government reserves the right to give or withhold approval of tariff changes and large or long-term loans and will supervise social and safety measures and regulate construction and maintenance.

Birdseye Party Completes Survey of Grand Canyon

U. S. Geological Survey Men Successfully Map Last Stretch of Treacherous Colorado—Dam Sites Investigated—Barely Escape Flood Waters—Thrilling Events Recounted

THE LAST stretch of the canyon of the Colorado that had not been surveyed in detail for accurate mapping, has at last been traversed by a party in charge of Col. C. H. Birdseye, chief topographic engineer of the U. S. Geological Survey, in a trip ended last month through 300 miles of the roughest waters and most treacherous section of the Colorado. The trip began at Lees Ferry, Ariz., and ended at Needles, Calif., and took approximately three months to complete. The chief purpose of the trip was to make an accurate survey of the canyon and to locate sites at which dams could be built to utilize the wasting waters for flood prevention, power development and irrigation. The trip was made in four principal boats, supplemented by a canoe, which however was later lost. These boats carried not only supplies and surveying and geologic instruments, but, except where portages were made, the members of the parties themselves.

The party consisted of well-seasoned experienced men, comprising, besides Col. Birdseye, E. C. LaRue, who has made a study of utilizing the Colorado River waters; R. C. Moore, state geologist of Kansas; R. W. Burchard, topographic engineer of the Survey, who had already surveyed the lower stretches of the river; Emery C. Kolb, of Grand Canyon, who with his brother made a boat trip from Green River, Wyo., through the Grand Canyon to the Gulf of California in 1911; Lewis R. Freeman, of Pasadena, Calif., explorer, writer and boatman; Leigh Lint, of Weiser, Idaho, and H. E. Blake, Jr., of Monticello, Utah. These two latter are young men of two years' experience in boating the rapids of the Colorado. Frank B. Dodge, of Honolulu, was another member of the party, being a skilful boatman, expert swimmer, and general utility man capable of filling any position from instrument man to cook. Frank Word, of Los Angeles, was the cook. About 90 miles below Lees Ferry, the party was joined by Herman Stabler, hydraulic engineer of the Geological Survey, and at Supai Creek by Felix Koms, who replaced Frank Word as cook. Following is an abstract of Col. Birdseye's report of the trip:

The party left Flagstaff, Ariz., July 18 for Lees Ferry, 140 miles away. One boat and all provisions and instruments for the trip were carried on two motor trucks. This 140-mile stretch of road included some perilous going over what is called the "dugway," a narrow road blasted out of the cliff, which at places rises about 300 ft. above the river. The job of steering a heavy truck laden with an 18-ft. boat around the perilous turns in this road lent considerable interest to the beginning of the trip. The other boats used were the property of the California Edison Co., and had been in use in 1921 in Cataract Canyon, above Lees Ferry. The party spent the rest of July making new topographic surveys around Lees Ferry and getting ready for the boat trip.

River Trip Begins—Leaving Lees Ferry Aug. 1 the party camped the first night 7½ miles below that place, where the radio set was tried out and in spite of adverse prophesies that a radio would be unable to get anything in the depths of the canyon, the Los Angeles broadcasting station was picked up. The canyon at that point is narrow and nearly 1,000 ft. deep. The next morning Badger Creek rapids were run. These rapids have a fall of 13 ft. in about 100 yd. and to the party just then beginning its trip, they looked wild, but later experiences with rough water made them appear slight upon recollection. Camp the second night was made about 11 miles below Lees Ferry, where the party learned by radio of President Harding's death about three-quarters of an hour after it occurred.

On Aug. 3 the party portaged boats and equipment past Soap Creek rapids, carrying and skidding the upper part of the rapids, but successfully running the lower rapids. These rapids have never been safely run by any party. It was man-killing work to portage the heavy wooden boats here. Perhaps we might have got through safely without portage, as we ran worse rapids later, but it did not seem wise to take the chance so early in the trip.

The first rapids which all the members of the party ran were encountered on Aug. 4—rapids which the party called "Sheer-Wall Rapids," due to the fact that there was no foothold for portage. Rapids were run with the boat stern first and with all occupants wearing life jackets of cork, with kapok collars. Members of the party lay face down in the boats, clinging hard to the life lines stretched across the deck. The waves seemed mountainous and to some of us our first ride of this kind was a genuine thriller, but we afterward became so used to riding rough water that we vied with one another to make the plunge with a lighted pipe or cigarette without losing the light.

On Aug. 5 the boat passed a boulder measuring 40 x 80 ft., rising 30 ft. above the water. This boulder, standing almost in the middle of the river, has been mentioned by nearly all who have written accounts of canyon trips. Seven rapids were run on Aug. 6. On the evening of that day, the party camped near some good springs on the right banks of the river, a place which was called Spring Cave rapids. In an attempt to "line" the canvas canoe around Spring Cave rapids, it was lost, the only mishap of the kind during the trip.

Dam Site Surveyed—After several other rapids had been run, on Aug. 8 the boat passed Vasey's Paradise, 31 miles below Lees Ferry. The party filled canteens from a large stream of clear cold water gushing from the cliff about 70 ft. above the river. Surveys of a possible dam site were made at this point, and camp was pitched on the limestone ledges at the head of another rapids where radio messages were received from Los Angeles broadcasting station.

On Aug. 9 about 41 miles below Lees Ferry, the party passed by some fine arches in the limestone wall of the so-called Marble Canyon. Here the walls, which rise about 2,000 ft. above the river, have been sculptured into remarkable forms by erosion and by the fall of great masses of rock. Advantage was taken of a severe rainstorm for all members of the party to get the first real bath they had had since leaving Lees Ferry.

On Aug. 10 the party remained idle as a tribute to the memory of the dead President.

Aug. 11 the boatmen ran the little fleet through Boulder rapids, below which quieter water was found, and in this stretch 46 miles below Lees Ferry the party passed three large caves, which they called the Triple Alcoves. On Aug. 12 Nankoweap Creek was reached and more clear water for drinking purposes was found. As the Colorado is decidedly muddy and carries 10 per cent of sand and other suspended matter, clear water for drinking was a luxury. In camp that night at the mouth of Kwagunt Creek, daily news items and baseball scores, as well as concerts, broadcasted from Los Angeles were picked up on the radio. The party ran Kwagunt rapids the next day, reaching the mouth of the Little Colorado River, which was in flood and poured into the main stream a great volume of yellow water, dirtier than that of the Colorado.

Marble Canyon Left—The mouth of the Little Colorado marks the end of what is called Marble Canyon and the

beginning of what is called the Grand Canyon, but the whole stretch of the river through the plateau from a point a few miles below Lees Ferry downstream might well be called the Grand Canyon. The distinction had been made, so the party began to reckon its progress down the canyon in miles from the mouth of the Little Colorado. That night the river rose 3 ft. and the party had to arouse itself and hustle to pull up the boats. By mid-August the party was thus working its way downstream through rapids after rapids, each day bringing its touch of adventure or experience. The engineers had become accustomed to rough water and wanted to ride the boats through the most threatening cataracts, and the better judgment of the boatmen had to be expressed forcibly to induce them to climb around on the rocky and narrow shore. At some places, however, portage was impossible, so the whole party had to shoot through on the boats together and take chances alike.

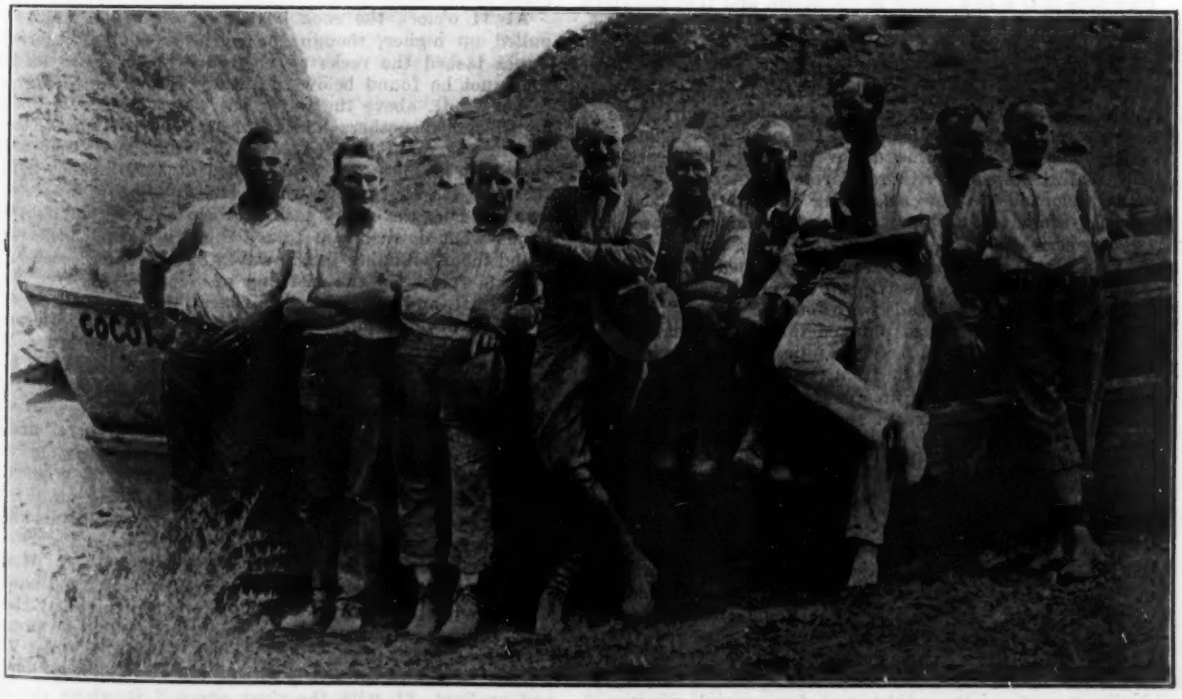
At the foot of Hance trail a pack train was expected, but as the party was more than a week ahead of its schedule, the train of course was not there, so three of the party climbed the canyon to its south rim at Grand View 5,000 ft. above and 15 miles away, reaching the rim at midnight and spending the night with a forest ranger, who drove them next day to El Tovar. The following day all returned to the canyon with a pack train bringing supplies and mail.

Re-equipped, the party passed Hance rapids, which is one of the worst on the river, having a fall of 28 ft. in a few hundred yards and being full of rocks over which the river surges in great waves. However, all boats made the trip safely, though all took water. Not far below Hance rapids, the party entered the upper Granite Gorge, a point where difficulty was experienced in securing a foothold for instrument and rod stations. However, the survey line was carried through without a break. The walls here are only about 125 ft. apart at the water's edge, and at some places the surveyors had to cling periously to small projections just above the swirling water.

Sockdologer Rapids Run—The dreaded Sockdologer rapids, 17 miles below the Little Colorado, were reached Aug. 21. The height of the fall here has been exaggerated greatly, amounting to only 19 ft., but most of it occurs in the first hundred yards. Waves measured 20 ft. from trough to crest. All members of the party had to take to the boats. The next morning the boats plunged into Grapevine rapids, which have a fall of 17 ft. in a few hundred yards and are full of rocks. At this place, as at most places in the Upper Granite Gorge, it is impossible to climb around the rapids, so that the whole party shot through in boats. Between all these perilous plunges down dangerous cataracts, the surveyors carried along their work. A continuous line was run through the canyon and detailed surveys were made of possible dam sites at several places.

At the mouth of Bright Angel creek, the party passed under the Geological Survey's gaging cable and the suspension bridge, a frail looking structure, affording the only good crossing to the north rim of the canyon in the whole stretch of the river through the plateau. At this point most of the members of the party climbed out of the canyon to return on Aug. 28 to find a Fox News operator prepared to take moving pictures of the party running the rapids. The operator rode in one of the boats with his camera and took a number of pictures of the party, both in camp and in the boats as they plunged through the rapids. The boats shot through rapids in quick succession at Pipe Creek, Horn Creek, Salt Creek and Monument Creek. The latter, shown on the Geological Survey's map as Granite Falls, has a drop of 17 ft. and is piled with great rocks that throw the water into high waves. Here the boats shipped considerable water.

Party Receives Visitors—On the evening of Aug. 29 the party camped at the mouth of Hermit Creek, where a good flow of drinking water was found. Here it was joined by Col. W. W. Crosby, superintendent of Grand Canyon National Park, and a large party that had been made up to see the boats run Hermit Creek rapids. So many visitors caused the cook to threaten to leave, so arrangements were made to replace him. Hermit Creek rapids proved to be extremely rough, the boats tossing about like corks on the huge waves, many of which broke over the boats. The fall here is about 15 ft. During the night of Aug. 30 a terrific thunderstorm wet the whole party in spite of rubber sleeping bags and other means of protection. As the rain bordered on a cloudburst, the next morning was devoted mainly to getting things dry.



U. S. GEOLOGICAL SURVEY PARTY WHO HAVE COMPLETED PRELIMINARY MAPPING IN GRAND CANYON
Left to Right—Leigh Lint, H. E. Blake, Jr., Frank Word, Col. C. H. Birdseye, R. C. Moore, R. W. Burchardt, E. C. La Rue, Lewis R. Freeman and Emery C. Kolb.

Crystal Creek rapids were next run, and on Sept. 2 the party reached Bass trail, where the pack train had brought a large stock of supplies, which were loaded into the boats taxing their capacity, yet consisting of no more than was necessary to carry the party to Diamond Creek, more than 100 miles below. The boats ran Bass Canyon rapids, passing under the upper Bass Ferry cable, upon which a man in a car can propel himself across the river with a windlass. The cable is about 50 ft. above the water and 300 ft. long. The lower Bass cable crossing is a few miles below, carries a smaller car, and appears to be not so secure. At this point detailed surveys were made for a promising dam site. Several miles below the lower cable crossing, the party encountered Royal Arch Creek, whose canyon contains a clear, cold stream and beautiful falls, pools, and fern dells. No account of any boat trip down the canyon contained any mention of this spot, but a Geological Survey party had evidently camped there, the remains of a camp fire being found and on the rocks nearby were carved Geologic Survey inscriptions dated May, 1905, and June, 1907.

Two Dangerous Rapids Encountered—After shooting these rapids, the most threatening having a fall of 15 ft., the party, after a day's run of 9 miles, camped on Sept. 6 at Specter Chasm. About a mile and a half below this place, the boats took an 8-ft. rapids, in which the party seemed to be in greater danger than at any other point. The channel was shaped like an "S," and the swift current tends to drive a boat against a large mass of rock lying halfway down the rapids. Two of the boats missed the rocks narrowly, one of them coming so close to it that Burchard touched it with his hand. One boat actually struck the rock, but so lightly that no damage was done.

On the morning of Sept. 8 the party reached a cataract that no preceding party had yet run. It had a fall of 15 ft. in a few hundred yards, and is full of rocks and bad holes. The first boat through grazed the rock and lost an oar, but the oar was recovered and the boat pulled through. After getting through, however, its operator signaled the others to take the midchannel. The next boat struck near the lower end of the rapids a rock on which it seemed to hang for a moment. On pulling out of the rapids, it was found they both had a bad smash in the stern, and that the stern hatch was leaking. This mishap consumed an hour in repairs with cotton waste, white lead, canvas, and copper sheeting. The other boats had no mishaps.

At the mouth of Tapeats Creek, which was reached on the afternoon of Sept. 8, the party found a cold stream of clear water and decided to spend the next day, which was Sunday, in camp. LaRue discovered that this creek had the greatest flow of any theretofore encountered, except the Little Colorado, its flow measuring 96 sec.-ft. About two miles up the creek the party found that half the flow came from a series of cascades from the west, and on tracing this side stream farther up found it gushed from a large cavity in the cliff. In the trip up the creek several Indian ruins and some arrow heads were found.

The next day the boats plunged through Tapeats Creek rapids and along rapids nearly a mile farther down, below which Deer Creek comes in from the right through a cleft in the wall of the canyon in a waterfall about 75 ft. high. A mile farther downstream some old Indian ruins were passed.

The party reached Fishtail Canyon at noon Sept. 10 and saw the eclipse of the sun, which there was 75 per cent total. The canyon looked particularly gloomy and desolate in the dim light.

Below Kanab Creek, the party found shelter from a long and violent thunderstorm in a cave at the head of a dangerous rapid. Here, after the storm, Kolb ran the rapids first and was drawn into a swirl in a big hole, where his boat turned upside down and he disappeared. Dodge at once plunged into the torrent and swam to the boat, catching it at the foot of the rapids. It had come up on the side of the river away from the party, and for several minutes it looked as if Kolb were gone, but Dodge found him under the cockpit, almost unharmed, though he did cough up some water.

Party Again Provisioned—Nearly at mid-September the party reached the mouth of Havasu Creek, 95 miles below the Little Colorado, and about 155 miles below Lees Ferry. Here Roger Birdseye and Charles Fisk, the provisioners of the party, were waiting with nineteen Supai Indians as packers, bringing supplies to last until the boats reached Diamond Creek, nearly 70 miles below. The Indians would not pack more than 40 lb. each and were so afraid of being overloaded that every man's pack was weighed at the Indian agency. Many amusing incidents were reported, such as the exchange of a package of oatmeal for a can of beans, in order to reduce the weight of the pack by a quarter of a pound. Although the reservation is less than 10 miles from the river, none of the Indians had ever made the trip down the narrow, steep gorge. Below Havasu Creek the boats were run through rapids safely and the journey was enlivened by thunderstorms and small adventures.

Camp was made on Sept. 18 on a small sandbar below the falls. At half past six in the evening the river began to rise and at 8 o'clock the boats, which were moored in a small cove, were pounding so badly it became necessary to find a safer place for them. Kolb and Lint therefore pushed off downstream in one of the boats in the darkness, with lantern and flashlight, and in about an hour returned overland to report that a small sand beach with a low shelving shore of limestone, up which the boats might be pulled, lay not far below, and that they had left the boat there.

Flood Threatens Disaster—No one expected a rise of more than 5 or 6 ft., but the river had already risen 3 ft. and the boats could not be held longer. There was space at this place for pulling one boat well above the water, so the cook boat was dragged up the side of the cliff by means of block and tackle. Kolb, Freeman, Lint, and Blake ran the other two boats downstream to the place selected, though not without difficulty. Freeman climbed back along the shore, but the other three remained for a sleepless night, for the water rose rapidly, and they were kept busy pulling one boat or another out of the water to a higher place on the bank.

At 11 o'clock the cook boat was afloat and had to be pulled up higher, though the job was not easy, for the waves lashed the rocks so vigorously that secure footing could not be found below the boat. Felix, the cook, went to bed 10 ft. above the water but was flooded out at midnight, and the others had to rescue his bed and clothes. During the night the beds with the cook's outfit had to be moved three times. I went to bed at 2:30 a.m. on a flat rock 20 ft. above low water but two hours later was awakened by the spray lashing the rock. At daylight all hands went downstream to see the other three boats and found them pounding in the waves but all safe.

At 8 o'clock on the morning of Sept. 19 the river had risen 16 ft. and it continued to rise all day, reaching a peak of 21 ft. about 6 p.m. The party spent most of the next day rather enjoyably in washing themselves and their clothing in the warm springs at this place, for the night had been chilly. Exercise was found in pursuit of a large rattlesnake, which was killed.

In the flood the rapids, which had been a short, almost sheer fall of 10 ft. at the crest, became a long sweeping "V" of swift water, and the waves below the crest for a quarter of a mile were running 20 ft. high and throwing spray that much higher. Immense quantities of driftwood, including many large logs, were carried downstream, and some of them were thrown completely out of the water. Measured in volume the rise was estimated to be 100,000 sec-ft. Evidently the rainstorms that had drenched the party from Sept. 13 to Sept. 16 were accompanied by worse storms farther up the canyon.

The river subsided slowly during the two following days, and on Sept. 22, with the river about 7 ft. above the old low water stage, the party resumed its journey.

Party Reports by Telegram — On Oct. 2 after running many small rapids, the party reached Diamond Creek, 164 miles below the Little Colorado, and 225 miles below the starting point. The party was reprovisioned and from that point telegrams were sent to Washington and elsewhere, reporting the safe arrival of the party and putting at rest rumors that the party might have suffered disaster because of the finding of a strange boat below. Here also the boats were overhauled, reports prepared, equipment examined, and radio outfit repaired and set up. Among the things received by radio was the announcement that the party itself had arrived safely at Diamond Creek.

The voyage was resumed Oct. 7, the boats plunging into Diamond Creek rapids. During that day Burchard fell on the rocks, fracturing a rib, but insisted on continuing his survey. With the exception of the first day's work below Lees Ferry he had made the entire survey and wanted to carry the line down to connect with his old work, just above the mouth of the Grand Canyon. He is therefore responsible for the entire survey through Marble, Boulder, Grand, and Black Canyons, from a point 7 miles below Lees Ferry to the Bull's Head reservoir site, about 40 miles above Needles. Though his rib was painful, bandages made it possible for him to continue the work.

Boat Thrown Into Air—Separation rapids were the next dangerous ones met. At the mouth of a deep canyon that comes in from the right, they fall nearly 20 ft., looking dangerous, and sheer walls leave no chance to pass around them. It is here that three members of the first Powell expedition are supposed to have left the canyon in discouragement, being soon afterwards killed by Indians. Kolb, Blake, and Lint ran their boats safely, but the deck loads made the boats top-heavy, causing them to dance about in the torrent like corks. Freeman ran last, with LaRue and Moore clinging to the hatches. The huge waves tossed the boat into the air, and when it came down, bottom side up, they were thrown out between the boat and the rocks, LaRue narrowly escaping being crushed. Freeman had dived clear of the boat and had come up a few yards from it, where he caught a rope. Blake and Dodge pushed out in their boat to render assistance. Dodge grasped the painter and helped to haul LaRue aboard, Freeman and Moore holding hard to the upturned boat, which was towed to quieter water and righted. All lost such loose articles as hats, pipes, and glasses, and Freeman lost both oars, which, however, were afterward recovered.

The accident afforded a good test of the serviceability of the watertight boxes, one of which, containing cameras, was strapped in the open cockpit of the overturned boat. After a half hour's submersion the cameras and films were found bone-dry. In camp that night, the radio set gave messages from Los Angeles, Salt Lake City, and for the first time from Colorado Springs.

Mattowitteki rapids, which lie below Mattowitteki Canyon, were next run. The fall here is 17 ft. in about a hundred yards, and the channel is dotted with rocks. One of Powell's boats broke loose while it was being lined around, and one man was thrown out but rescued. These rapids—the last bad fall on the river—are considered the worst in the canyon except Lava Falls. The boats were lined through by using long lines held by men at several points along the cliff. The job of handling these 900-lb. boats and portaging equipment was not easy.

On Oct 13 Burchard brought his line to the monument marking the end of his work in 1920, at Last Chance rapids, 252 miles below Lees Ferry, and checked his elevations, finding only a slight error. On Oct. 15 the voyage downstream was resumed, and the party reached Needles, 450 miles from Lees Ferry, on Oct. 19.

To the able leadership of Colonel Birdseye is attributed a large measure of the success of the trip. The persistence of "the indefatigable Burchard" was a matter of comment among his companions as was the skill and good judgment of Emery Kolb in piloting the boats through the rushing waters of the canyon.

Siltation of Austin and Lake Worth Reservoirs in Texas

By John B. Hawley
Consulting Engineer, Fort Worth, Texas

Remarks before Texas Section, Am. Soc. C. E., Oct. 5, 1923.

DEAN T. U. TAYLOR'S excellent paper on the silting up of the Austin reservoir in *Engineering News-Record* for Sept. 6, p. 380, while accurately setting forth the facts, is quite likely to be too greatly generalized by the casual reader, even to the extent of concluding that reservoir construction in Texas is a futile undertaking.

The situation at the Austin dam is quite unusual, especially in respect of the great drainage area, 37,000 sq.mi., for an original impounding capacity of 16,800,000,000 gal., or 51,000 acre-ft. Dean Taylor shows that 84 per cent of the capacity of Lake Austin was filled with silt from 1913 to 1922 (reducing a capacity of 33,745 acre-ft. to 5,456 acre-ft.). This makes Lake Austin look quite like a mere "sand-trap" for the 37,000-sq.mi. drainage area.

Now Lake Worth, on the West Fork of the Trinity River, six miles west of Fort Worth, has been in service slightly more than nine years, 1914 to 1923. Its drainage area is about 1,600 sq.mi., the areal geology of which is quite similar to that of the Colorado River above Austin. The gross capacity of Lake Worth, at spillway level, is, or was, about 14,000,000,000 gal. or 42,000 acre-ft.

In the Austin case 37,000 sq.mi. fed 33,000-acre-ft. capacity, or 1.12 sq.mi. for each acre-foot. In the Fort Worth case 1,600 sq.mi. fed 42,000-acre-ft. capacity, or 0.038 sq.mi. for each acre-foot. Axially, Lake Worth is about twelve miles long and has an average width of a half mile.

Some months ago, when the water level of Lake Worth was 4 ft. below the spillway, John F. Norris, Simon W. Freese and the writer carefully examined the shores of Lake Worth, digging through the reddish silt into the original black loam. The line of contact was clearly defined. Near the dam we found an average of ¾ in. of silt; 3½ mi. above the dam, 1½ in. of silt; and 7 mi. above the dam 3½ in. of silt. The last observation was made about ¼ mi. above the "Nine Mile Bridge," just below the "narrows" between the "upper" and "lower" lakes. Sometime later the writer made some examinations near the upper end of "upper lake," and found 2 to 3 ft. of silt at the low-water mark.

Lake Worth Siltation—The data are inadequate to estimate siltation for the nine years, as the depths of the lake will show much greater silt deposit than the shallows, but the contrast between them and Dean Taylor's figures for Lake Austin is striking. However, if Lake Austin, with approximately the same capacity as Lake Worth, was 84 per cent filled by silt from 37,000 sq.mi. of drainage area in nine years, then perhaps Lake Worth, with but 4½ per cent of that drainage area, might go 207 years before accumulating silt to 84 per cent of its original capacity. Again, assuming that the 4,200-acre water surface area of Lake Worth has been silted an average of 1 ft. during the nine years (and this assumption is deemed excessive) the silt volume would be but 10 per cent of the original capacity, as against 84 per cent in the case of Lake Austin.

The State Board of Water Engineers and the Engineers of Water Resources (for Texas) of the United States Geological Survey recently decided to make soundings on traverse lines to be established on Lake Worth, and to continue observations on its siltation through a long period of years. Data secured by these observations will be eagerly awaited by the profession.

The many impounding and storage reservoirs on Texas streams, and streams in every other state, many of them in useful service for decades, should be ample evidence to engineers, and to communities contemplating the conservation of surface waters, that the siltation troubles experienced at Lake Austin are substantially unique, being probably the most unusual in the history of engineering.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

An Engineer on City Charters

THE BEST CITY CHARTER—By Robert J. Harding, M. Am. Soc. C. E. With an introduction by George Chandler Whipple, Professor of Sanitary Engineering, Harvard University. San Antonio, Texas: The San Antonio Water Co. Paper; 6x9 in.; pp. 89.

As engineer and administrative officer for cities in the North and as chief engineer, manager and vice-president of a water company in the Southwest, Mr. Harding has had both experience in city administration and much contact with city governments. In addition he has collected and studied city charters of different types. The result of all this, plus much thought on the subject, is this essay on The Best City Charter.

Briefly, the author believes that a city charter should take the doctrine of representative government as its basic principle and the Constitution of the United States as its model. While seeing some advantages in the commission and commission manager as contrasted with earlier types of city charters, Mr. Harding is against both of the newer forms. These he considers unrepresentative and, as regards their common accompaniments—the initiative, referendum and recall—ultra democratic. But, strong as he is for representative government, he proposes to deprive the voters of the power to choose one-third of the city council by having the choice made by the mayor—from citizens especially qualified for the purpose who would at the same time raise the level of a body of ward representatives. So far as we know, such a limitation of representative government has never before been proposed.

Impressed with the fact that the commission plan is an abandonment of the separation-of-function-and-power idea of the American Constitution but largely if not wholly ignoring the development, a few decades back, of the federal type of charter, as at Brooklyn and Cleveland, and in the first model charter of the National Municipal League, Mr. Harding proposes a decidedly mixed type of charter with (1) a mayor of limited executive power; (2) a council with practically none but legislative functions; (3) numerous administrative boards on the theory that by this means the interest and knowledge of representative citizens will be put at the disposal of the city; (4) department executives and employees, apparently chosen in part by their immediate heads and in part by civil service commissions, but not as regards men to fill technical positions. Except for the health commission, these administrative boards seem to be limited in power to (1) the choice of an executive head of the department; (2) carrying out policies established by the city council and expending money provided by the budget; (3) recommending measures to the council for approval.

An engineering board would appoint a city engineer, initiate street widening and extension projects and have some control over utilities that use the streets, but there would be a board of public works to initiate public improvements and to construct and operate various public works, under the "direction of a man," chosen by the board, "preferably a municipal engineer with wide construction experience." In cities of less than 50,000 these two boards might be combined. The health board would have charge of plumbing and of city scavenging. There would be no curb on its expenditures so long as they were for public health.

The mayor is held to be the chief executive but from Mr. Harding's outline he seems to be that only in so far as appointment of board members is concerned. The mayor is also the "prime mover" as to policies while the council acts "as a buffer between the initiative [initiator?] and the people." Mr. Harding differentiates between the administrative and the executive functions of city officials, and Professor Whipple, in his introduction, enlarges considerably upon Mr. Harding's few lines on this subject. Both have in mind (1) legislation; (2) administration, to work out the details of legislative policies; and (3) execution of those policies as thus detailed, but Mr. Harding's scheme does not follow this division in a clean-cut way.

Rightly or wrongly the essay gives the impression that the author has largely ignored much if not most of what others have written on democratic institutions, representative government and city charters. Other proposals to improve city government, especially by the commission and commission-manager plans, adopted in the last twenty years by some six hundred cities and given up as yet by very few, the author characterizes as innovations, prompted by a desire to change. Notwithstanding the foregoing criticisms Mr. Harding's essay is well worth reading, especially by engineers, but those not already familiar with the two-hundred commission-managers charters now in use and with the theory and practice of charter making will do well to refer to Crane's "Digest of City Charters," and to read one or more of the many recent books on government—federal, state and municipal—and also Mill on "Representative Government."

The Engineer Who Makes a Speech

REVIEWED BY P. B. McDONALD

Professor of English, College of Engineering, New York University

PLATFORM SPEAKING—By G. Rowland Collins, of New York University. New York: Harper and Bros. Cloth; pp. 341; $2.25.

For the engineer who has to make a speech here is a useful book of instructions designed especially for professional and business men. All varieties of formal talks, from the sales argument to the after-dinner speech, are discussed in a practical and helpful manner. The technicalities of voice and action are minimized, and stress is laid upon preparation rather than upon presentation in the old-fashioned elocutionary style. Analyses of purpose, subject matter, and audience are particularly well treated. While avoiding the old elocutionary etiquette, the author has not gone to the other extreme and descended to "pep" phrases and inspirational lingo. The methods of effective persuasion and argumentation are made plain.

From Serbian Cattle Herder to Scientist

FROM IMMIGRANT TO INVENTOR—By Michael Pupin, Professor of Electro-Mechanics, Columbia University. New York: Charles Scribner's Sons. Cloth; 6x9 in.; pp. 396, 25 halftones. $4.

Seldom does an autobiography have such breadth and height of interest as does Prof. Pupin's story of how a boy cattle herder in Serbia became an American scientist of world-wide fame. Many other foreign-born youths of humble origin have seized the opportunities presented after their arrival in America, but few have combined such great achievements in physics and engineering with devotion to such high democratic and humanistic ideals and put the whole on record in engaging and inspiring form.

What influences opened Pupin's mind as a youth and brought him to America, his hardships and experiences as a "greenhorn," his entrance to American citizenship and his achievement of a college degree at Columbia; his later studies at the Universities of Cambridge and Berlin, and his professorial and research work at Columbia University, and many things besides, are charmingly told in the first ten chapters of this autobiography. The concluding chapters, on The Rise of Idealism in American Science and on The National Research Council are brimful of suggestion and inspiration. Both of these chapters contain an eloquent plea for scientific research both "pure" and practical. Tributes are paid to the American Society of Civil Engineers and the other three "founder" engineering societies; to the National Academy of Arts and Sciences and to the National Research Council, growing as these two did from the Civil War and the great war of recent years; and particularly to Andrew Carnegie and Ambrose Swasey for their generosity and perspicuity in establishing respectively the United Engineering Library and Engineering Foundation. Other contributors to the promotion of science, both by their own research work and by their benefactions, are not overlooked, nor does the author fail to mention progress in other scientific fields than his own, mentioning in particular progress in biological science in the past twenty-five years.

As an illustration of Prof. Pupin's keen reflections upon many phases of human life and progress, mention may be made of a contrast which he draws in a few sentences between the great industrial work accomplished by Carnegie and by Swasey: The former "achieved great things in mass production," while the latter specialized in the production of "fine machine tools and astronomical instruments of precision."

All through the book notable instances are given of how things seemingly little at the time have a profound influence upon the development of knowledge and character in those who make the best of every opportunity for the advancement of themselves and of the world. It was the chance finding, the immediate purchase and the eager study of a second-hand book from a Paris bookstall that laid the basis for the development many years later of the Pupin inductance coil which has played such a part in the development of telephony during the last two decades. This book was La Grange's "great treatise, 'Mechanique Analytique,' first published under the auspices of the French Academy in 1778." Throughout his book Prof. Pupin refers again and again to his early experiences in the transmission of sound through the earth when he and other herdsmen signaled back and forth by that means.

Prof. Pupin's autobiography is a crowning addition to several most interesting books in this field of literature, that have been reviewed in these columns during the past few years. Like the others, this one can be recommended for reading by any engineer and particularly by students of engineering or of science, or for that matter by any of the youth of the land who are in the formative stages of their career. Many of the persons who within the next few weeks will be racking their brains to think of a suitable holiday present could safely obtain this volume for that purpose, but they should either get the book long enough to read it themselves before giving it away or else purchase two copies.

Addition to Turner on Elasticity

REVIEWED BY GEORGE PAASWELL
Specialist in Mathematical Engineering Problems, New York City

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section III, Theory of Torsion in Shafting and Double Bending of Plates—By C. A. P. Turner, Consulting Engineer, M. Am. Soc. M. E., M. A. S. T. M., M. Am. Soc. C. E. Minneapolis, Minn.: Published by the Author. Cloth; 6x9 in.; pp. 122; 132 line cuts. $5.

Section III of the series of texts on elasticity purports to cover the theory of torsion and of double bending. The latter treatment is that given in the book issued jointly by Mr. Turner and the late Prof. Eddy, reviewed in these columns, Feb. 15, 1923, p. 312. But little need be added or retracted from that criticism.

Mr. Turner deserves much admiration for his sincere (and obviously costly) endeavor to bring to the attention of the average designer the more exact treatment of structures by the method of the mathematical theory of elasticity, but one notes with deep regret how unsuccessful a mere qualitative description of stress is. As the reviewer has pointed out previously, no proper description can be given without the aid of mathematics. The reader will not accept fundamental explanations upon the mere say so of the author.

The qualitative description of torsion is ably presented, if one overlooks the annoying intrusions of the author's special terminology, such as rotative and twisting shears. There are three fundamental strains in elastic theory—lengthening, shortening, and shear—and three fundamental stresses—tension, compression and shearing stress. The student can recognize these anywhere. Why confuse him by a special type of name?

St. Venant presented in complete form the exact theory of torsion, analyzing not only the circle, but all types of shapes, and gave an empiric formula that covered almost all cross-sections. Only the circle maintains the plane section during torsion and the old torsion formula is exact for this section alone. The author notes a bulge in the circular section; is that consistent with the demonstration that the circular section is not distorted?

In discussing plate action the author again makes the twisting shear the mysterious force maintaining plate action. This twist is merely a flexural action and the reader need expect no new data on plate action.

A minute's discussion may explain the difficulty in analyzing plate action by the exact theory of elasticity. Upon the simple assumption that Hooke's Law is valid, and upon the continuity of the body, differential equations are built up to be satisfied by the boundary and surface conditions of the deformed body. For the plate,

the data are too complex to lead to any solution of the plate, unless certain approximations are made. A solution can then be found for the circular, elliptical and rectangular plate resting on its periphery, and Michell has extended the solution by means of a theorem in inversion to a plate carrying an isolated load. The flat plate on four columns has not yet received any mathematical solution. Approximations may be found by dividing the surface into convex and concave dishes and applying the formulas for circular plates, properly modified to allow for the terminal bending stresses. This gives a very rough approximation, but it may be a limiting stress condition. The author might well have described some action as above and given the reader a comprehensible idea of plate action; he chose rather to found his analysis on twisting action, to the reader's confusion.

To sum up, while the text may illuminate, in a qualitative sense, torsional and double bending effects, the treatment as a whole can hardly be considered an addition to our knowledge of elastic action in plates.

British Presentation of Sewer Hydraulics

REVIEWED BY JOHN H. GREGORY

Consulting Engineer; Professor of Civil and Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

HYDRAULICS APPLIED TO SEWER DESIGN—By G. S. Coleman, D.Sc. Eng. (London), Assoc. M. Inst. C. E., Associate Member of the Institution of Municipal and County Engineers, Senior Lecturer in Municipal and Sanitary Engineering in the Municipal College of Technology, Manchester, England, and Assistant Lecturer in the same subjects in the Victoria University of Manchester. London: Crosby Lockwood and Son. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 150; 70 line cuts. $4.

In his preface the author says, "The following pages are founded on notes of lectures delivered to third-year students sitting for the B.Sc. Tech. degree in Municipal and Sanitary Engineering in the Victoria University of Manchester, and also on notes collected by the author from his own practice as a municipal engineer for the past twenty-five years." In its present form the book is by no means a textbook for students in sanitary engineering, nor is it a brief treatise for the practicing engineer. Apparently it is an attempt on the part of the author to put in printed form the main essentials of hydraulics, applied to sewer design, as they appear to him.

From the standpoint of American practice the book is of little value, and as for considering the subject of hydraulics, some phases are not even mentioned, as velocity head, loss of head at entrance, and discharge through orifices. With some of the author's statements the reviewer ventures the opinion that engineers may not agree. For example, in discussing discharge formulas for channels the author says, "It is usual to allow a limiting average velocity of 3 ft. per second in vitrified sewer pipes and from 2 to 1 ft. per second in large sewers, the smaller value applying to the largest sizes. Sewers should never be put under pressure unless constructed of metal pipes." Engineers interested in the rational method of estimating storm water runoff will, however, find a brief but interesting discussion of this subject, especially as regards the time of concentration along a main sewer of the runoff from contributing areas.

The book is well printed and bound, but the illustrations are not well executed. An index is included. The sum of $4 net is far too high for the material presented.

Chief of Engineers of the Army

THE OFFICE OF THE CHIEF OF ENGINEERS OF THE ARMY: Its Non-Military History, Activities, and Organization—By W. Stull Holt. [Institute for Government Research, Service Monographs of the U. S. Government, No. 27.] Baltimore, Md.: Johns Hopkins Press. Cloth; 6x9 in.; pp. 166. $1.

No branch of the government has a more honorable history than the Corps of Engineers. Certainly every civil engineer, whether in military or civilian life, should be acquainted with that history. This book, issued as one of the series of the service monographs of the United States Government, is an excellent unprejudiced statement of the Corps' duties and performances. Appendixes give summaries of the laws under which the Corps of Engineers functions, financial summaries, statistics of floating equipment and a bibliography.

PUBLICATIONS RECEIVED

THE REPORT AND RECOMMENDATIONS on a Physical Plan for a Unified Transportation System for Chicago, abstracted in our issue of July 19, 1923, p. 104, may now be obtained from the Bureau of Statistics and Municipal Reference Library, City Hall, Chicago, Ill.; $2.25 postpaid.

POWER TEST CODES, a Test Code for Hydraulic Power Plants and Their Equipment, has been published by the American Society of Mechanical Engineers but distribution has been held up pending a decision as to whether a revised edition, to include certain changes, will be substituted for the present edition. (American Society of Mechanical Engineers, 29 West 39th St., New York. 70c. to members; 80c. to others; 25 or more copies, 65c.)

BOILERS used exclusively for low-pressure steam heating, hot water heating, and hot water supply are covered in Section IV of the American Society of Mechanical Engineers Boiler Code, 1923 edition. This part of the code has been entirely rewritten since the 1918 edition and as now presented it includes rules governing the construction and operation of steel and cast-iron boilers. (New York; 80c. per copy, 70c. to members; 25 or more copies, 65c. each.)

THOSE WHO FREQUENTLY USE mathematical tables and formulas in practical work, including the geometer and physicist, will find "Synopsis of Applicable Mathematics: with Tables," by L. Silberstein, Ph.D., a convenient volume. The Tables are logarithms of numbers and of the trigonometric functions, and special tables, such as elliptic integrals and the Bessel function. The formulas are the applicable formulas of algebra, geometry, trigonometry and calculus. Non-euclidian geometry is taken up and special attention is given to vector geometry, the quarternion, and tensor calculus. (First published September, 1922, as "Bell's Mathematical Tables;" Reissued April, 1923, as "Synopsis of Mathematical Tables." Printed in Great Britain by Neill & Co., Ltd., Edinburgh. New York: D. Van Nostrand Co.; $4.50.)

IN THE ROUTINE OF DRY GOVERNMENTAL REPORTS a decidedly unusual degree of interest attaches to a pamphlet just issued by the U. S. Department of Agriculture, under the title "Timber: Mine or Crop?" It is a comprehensive review of the lumbering situation and forest stock of the country, supported by a surprising mass of data on growth, cut, consumption and waste. As a short and easily digestible historical review of the development of American forest exploitation, and of the tremendous changes that have come upon different lumbering states in the course of this exploitation, the engineering reader will find it of particular value. The progress of the center of lumbering from New England to the Lake states, then to the South and now to the West, is outlined; the ruin that has descended upon many sections, such as parts of Pennsylvania and Michigan, through non-conservative exploitation of forest resources, is illustrated; finally, proof is given

that unless wasteful exploitation is stopped and at the same time forest growth is multiplied several times by the adoption of sounder cultural methods, the country will be without a sufficient wood supply in the not far distant future. Not least interesting in all this material are various sidelights on subordinate phases of the general problem such as the menacing part played by the retail lumber dealer in profiteering in our wood resources and the unfortunate influence of decreased water transportation of lumber. There can be little doubt of the importance of the recommendations of the report, whose alternative, the text concludes, "is idle forest lands and timber bankruptcy."

THOSE INTERESTED IN SHORE PROTECTION will find the latest Report of the New Jersey Board of Commerce and Navigation on The Erosion and Protection of the New Jersey Beaches of considerable interest. The report itself is brief, consisting of an outline of the methods followed by the engineering advisory board and its recommendations, but the appendixes are very full. They include an historical account of the changes in the New Jersey shore line, the general principles of coast protection, illustrations and descriptions of beach protective devices, a discussion of action of winds, currents and littoral drift, practice in beach protection in other places, and an outline of the New Jersey laws concerning riparian lands as affected by erosion. The report also contains a set of large scale maps of the New Jersey coast showing the changes in the above line during the past century.

WATER SUPPLY PAPER 494, an Outline of Ground-Water Hydrology, with Definitions, prepared by Oscar E. Meinzer, has been issued. (One copy free, U. S. Geological Survey, Washington, D. C.)

THE LATE WAR delayed completion of the Report on the Study of Fifteen Representative Sewage Treatment Plants, by H. H. Wagenhals, E. J. Therriault and H. B. Hommon, recently issued as Bulletin 132 of the U. S. Public Service. (Washington; paper; pp. 257; one copy free on application, as above; additional copies at 50c. from Superintendent Public Documents.) The plants studied are located at Alliance and Canton, Ohio; Atlanta, Ga.; Fitchburg, Mass.; Lexington, Ky.; Columbus, Ohio; Rochester, N. Y.; Baltimore, Md.; Reading, Pa.; Houston, San Marcos and Sherman, Texas. One-story and Imhoff septic tanks, contact beds, trickling filters and Riensch-Wurl screens in various combinations and (in Texas) activated-sludge process were studied. The plants are described and the results of analyses, made by the investigators for this report, are given. The report is so unique and valuable that every engineer engaged in sewage-works design or operation should obtain a copy.

THE ENGINEERING EXTENSION SERVICE of Purdue University, Lafayette, Ind., has issued a bulletin on Electric House Pumping Systems, by Professors G. C. Blalock and D. D. Ewing.

A.S.T.M. TENTATIVE STANDARDS, 1923, covering 170 subjects, is now available. (American Society for Testing Materials, 1315 Spruce St., Philadelphia; 859 pp.; $7 in paper or $8 in cloth.)

THE AUTOMOBILE, improved highways, the wanderlust and the desire to "camp out" make opportune a Florida State Board of Health Bulletin on Tourist Camps, their Sanitary Control and Operation, by George W. Simmons, Jr., chief sanitary engineer (Jacksonville). Revised camp rules are included.

Foreign Papers and Reports

THE EXCELLENT WORK of the Newcomen Society (H. W. Dickinson, secretary, The Science Museum, South Kensington, London, S.W. 7) "for the Study of the History of Engineering and Technology" is continued in Transactions, Vol. II, 1921-22. Among the papers included are: The Early History of Mechanical Handling Devices, by G. F. Zimmern; Greek and Roman Engineering Instruments, by R. C. S. Walters; and Mechanics and Engineering from the Time of Aristotle to that of Archimedes. Other papers deal with early railway and locomotive matters, steam navigation, etc. A short analytical biography of the History of Engineering and Applied Science, 1900-1920, is included. A number of interesting old cuts are reproduced. Membership in the society is open to all interested anywhere.

SEWAGE RESEARCH STUDIES at Moscow, 1903-22, are the subject of a 32-p. pamphlet printed in Russian, but with a résumé in French, by S. Stroganoff, chief of the sewage laboratory of the city of Moscow.

New Books and Revised Editions

DESIGN OF CONCRETE STRUCTURES—By Leonard C. Urquhart, Assistant Professor in charge of Structural Engineering, Cornell University; and Charles E. O'Rourke, Assistant Professor of Structural Engineering, Cornell University. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 452; 166 line cuts. $4.

THE DESIGN OF DIAGRAMS FOR ENGINEERING FORMULAS AND THE THEORY OF NOMOGRAPHY—By Laurence I. Hewes, B. Sc., Ph.D., M. Am. Soc. C. E., Deputy Chief Engineer, U. S. Bureau of Public Roads; and Herbert L. Seward, Ph.B., M.E., M. Am. Soc. M. E., Associate Professor of Mechanical Engineering, Sheffield Scientific School, Yale University. New York: McGraw-Hill Book Co., Inc. Cloth; 9x12 in.; pp. 111; 83 line cuts. $5.

EISENBRÜCKENBAU—Dritter Band. Die Hauptträgersystemz Nebst Ihrer Berechnung Bauliche Einzelheiten Der Balken-Bogen- Und Hängebogenbrücken Bauliche Einzelheiten Der Hängerbrücken Herstellung Der Eisenbrücken in Der Werkstatt Und Auf Der Baustelle. Von George Christophe Mehrtens, Geh. Hofrat und Professor der Ingenieur Wissenschaften an den Technischen Hochschule in Dresden. Leipzig: Wilhelm Engelmann. Paper; 7x10 in.; pp. 435; halftones and line cuts.

"HUTTE": TASCHENBUCH FÜR EISENHÜTTENLEUTE—Herausgegeben vom Akademischen Verein Hütte, E. V. Berlin. [Dritte Durchgesehene Auflage.] Berlin: Wilhelm Ernst & Sohn. Cloth; 5x7 in.; pp. 963; 511 line cuts.

HYDRO-ELECTRIC POWER STATIONS—By David B. Rushmore and Eric A. Lof. [Second Edition.] New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 830; 437 halftones and line cuts. $7.50.

INDUSTRIAL OIL ENGINEERING—By John R. Battle, M.E., C.E., Assoc. M. A. S. M. E., M. Engineers' Club of Philadelphia. [Second Revised Edition.] Philadelphia: J. B. Lippincott Co. Cloth; 6x8 in.; pp. 1141; 400 halftones and line cuts, 9 charts, 9 colored plates. $10.

POPULAR FALLACIES EXPLAINED AND CORRECTED (with copious references to authorities)—By A. E. S. Ackermann, M. Assoc. Consulting Engineers, Assoc. M. Inst. C. E. [Third Edition.] London: The Old Westminster Press. Cloth; 6x8 in.; pp. 984.

PRACTICAL CONTROL OF ELECTRICAL ENERGY—By Alfred George Collis, A. M. I. E. E., M. Am. I. E. E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York: Oxford University Press. Cloth, 6x9 in.; pp. 160; 142 halftones and line cuts. $3.50.

Intended to give "descriptive technical data of the design of electrical apparatus and machinery, as applied to everyday practice," and to explain and solve "alternating and direct current problems intelligently without the introduction of complications and formulas."

THE PREVENTION OF VIBRATION AND NOISE—By Alec B. Eason, M. A. (Cantab.), Assoc. M. Inst. C. E., A.M.I.E.E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York; Oxford University Press. Cloth; 6x9 in.; pp. 163; 65 halftones and line cuts. $5.

STRENGTH OF MATERIALS: Prepared in the Extension Division of the University of Wisconsin—By Walter E. Wines, Assistant Professor of Mechanical Engineering, University of Wisconsin. [Engineering Education Series.] New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; 103 halftones and line cuts. $2.25.

A TREATISE ON ENGINE BALANCE USING EXPONENTIALS—By P. Cormac, Fellow of the College of Science for Ireland, Demonstrator in Mechanical Engineering at the College of Science, Dublin, Lecturer in Heat Engines and Motor Car Engineering at the City of Dublin Municipal Technical Institute. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. 151; 55 line cuts. $8.

THE WELDING ENCYCLOPEDIA: A Practical Reference Book on Autogenous Welding—Compiled and Edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of The Welding Engineer. [Third Edition.] Chicago: The Welding Engineer Publishing Co. Flexible; 6x9 in.; pp. 360; many halftones and line cuts, some colored plates. $5.

This (the third) edition of a book first published in 1921 contains a new chapter on training oxy-acetylene and electric arc welders, and additional matter on welding tanks and pipes.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Responsibility for Timber Treating Inspection

Sir—Within two years, we have had two failures on the part of inspection bureaus to detect failure on the part of plant management to live up to the specifications on creosoted timbers. In one case the quality of timber was involved; in the other, exact lengths. This concerned the same contractor, but different treating companies and different inspection bureaus.

Our contract provides that progress inspection does not relieve the contractor of responsibility for defects discovered at a later time. The extra expense incurred by the contractor was not relatively large but there was also delay and annoyance. The treating company in each case claimed that when we sent an inspector the responsibility rested with the inspector while the inspection bureaus each stated that the current rates for such inspection are so low that it would be suicidal to guarantee such details of inspection as were involved, or to make good any losses incurred by the contractor.

A recent conference in this office with the three interests involved in the last case seemed to bring out the fact that there should be either less responsibility placed on the inspection bureau and therefore more on the treating plant management, or else more on the inspection bureau with the plant management and contractor relieved from all subsequent responsibility.

The question of equity seems somewhat involved. When the county employs an inspection bureau whose representative passes on the material and treatment at the plant, and it later develops that there has been a failure to comply with the plans and specifications, should the county, acting through an inspection bureau as its agent, be responsible to the contractor, thus waiving the clause in the contract touching on progress inspection?

No doubt this question has arisen in other instances, and I should be glad to have an expression from others in regard to the equities involved.

V. R. COVELL,
County Engineer,
Allegheny County.

Pittsburgh, Pa.
Oct. 24, 1923.

Making Contract Bids More Certain

Sir—The article "Overlooked Items in Estimating Road Work" in *Engineering News-Record* Sept. 6, 1923, p. 391, holds a great deal that is applicable to construction contracts in general. The item set forth in the first paragraph of the subtitle, "General Factors," and more definitely estimated as 15 per cent as the minimum that should be added to cover risks embraced in the so-called "Unilateral Contract" usually submitted by the owner, is a puzzling item for most construction contractors.

Contractors frequently submit alternate bids for doing work of construction through the use of substituted materials or equivalent procedure. Why not submit alternate forms of agreement to the owner? The contractor is in a position to form his agreement so as to reduce these hazards: (1) Acts of God; (2) delays and suspensions of work by owners; (3) unusual increase or decrease in contract quantities; (4) absence of means for legal redress for inequities or arbitrary decisions, and (5) the unilateral form of contract, under which one is generally compelled to bid and by which the contractor may be penalized for one or all of the above contingencies.

Items 1 and 4 are frequently but little understood by either contracting party as to the legal decisions affecting these terms when used in the uniform contract.

Items 2 and 3 are frequently the cause of disputes for which the clause in the contract provides a committee or referee. The unilateral form of contract is in a sense a misnomer, as it presumes the doing of an act in reliance upon the promise of another. This term, "unilateral," is a technical term distinguishing a contract of this nature from a so-called bilateral contract, where the promises and performances are said to be mutual.

Now, a word in closing as to the term "penalties," which is very misleading. Where the owner and contractor agree upon certain sums to be paid on breach of the contract (by either) it may be recovered if intended as liquidated damages for non-performance, but the weight of decisions by American courts shows that penalties will not be enforced and recovery is limited to the loss actually sustained.

In view of the conflicting laws of the various states, it is impossible to reconcile the use of the uniform contract in its present form without reference to the state decisions where the construction contract is to be performed. A saving of 10 per cent is worth while by either owner or contractor if this can be done through the substitution of an alternate form of agreement which will allow "bids to be more definite" and assure completion of construction without actual or threatened litigation.

HORACE H. SEARS,
Consulting Engineer and Attorney at Law.

New York City, Oct. 6, 1923.

"Sand-Hogs" or "Sand-Braves"

Sir—Occasionally there is in the daily press an expression or phrase that may be without a worthy origin and therefore a subject for comment. Engineering affairs are involved.

In deep foundations and caissons in the present state of the art employees are frequently obliged to work where health and life are in constant peril. Why are such laborers so often called "sand-hogs"? Apparently the words are a misfit. If not rude or harsh as some might argue, since no repugnance is felt by employer or scribe, still the last word implies a condition and sundry activities that have been fostered by man through irregular feeding and want of care. In nature the pig is an exceptionally neat creature, no more intent upon food than many other mammals, and it is far from being without wit or good sense. Besides in sterling ancestry the pig can claim distant kinship with the mighty mammoth of the past and the elephant of today as we have all known since a London meeting of the Royal Society about the year 1876 when it was declared that,

> "A very tall pig with a very long nose
> Sends out a proboscis quite down to his toes
> And thence by the name of elephant goes
> Which nobody can deny."

The papers say that many of the workers come from the West Indies. Kinship there has not been free from man's influence. Perhaps an early forbear was in "the fifty-foot boat" that astonished Columbus off the Honduras coast. It required stamina to endure the civilization of the white race for four hundred years whether the sufferers were of American or African descent. And today the man who passes the physician's test and works under an air pressure of 40 lb. in a temperature of 130 deg. F. must possess some qualities of value to the human race and might well be envied by groups of men who spend much time looking for a soft place and never get below the surface of things.

Courage that results in convenience to the public passes unnoticed while admiration for an inferior sort exhibited in the prize-ring is limitless. In caisson work as in many other kinds of employment there is opportunity for different degrees of intelligence and for quick action. Was not the workman who was driven through the roof of a tunnel and 30 ft. of water by an air bubble rushing to stop a leak?

If *Engineering News-Record* were to suggest that "sand-braves," harking back if you please to tribal times, would be a just replacement there is little doubt but that the press would quickly follow its lead.

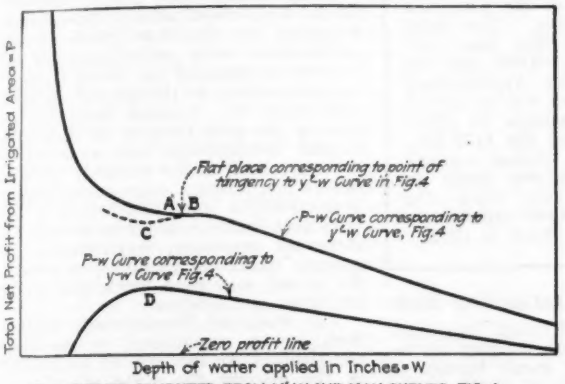
H. F. DUNHAM,
Civil Engineer.

New York City,
Nov. 1, 1923.

More on Duty of Water Tests

Sir—The very interesting paper on "The Economical Use of Irrigation Water Based on Tests," which appeared in *Engineering News-Record*, Oct. 4, 1923, contains a slight error under the discussion of the authors' Case 2. The error does not fundamentally affect the purpose of the paper but it is believed that it should be pointed out on account of its mathematical significance.

Near the bottom of the first column, page 550, in discussing the situation which arises when $\frac{b}{a}$ is less than the value of the *y-w* curve for zero water application, the following statement is made, "Should there be a point of inflection on the curve, which is very improbable, a tangent


Total Net Profit from Irrigated Area = P
Flat place corresponding to point of tangency to y'-w Curve in Fig.4
A
B
C
P-w Curve corresponding to y'-w Curve, Fig.4
P-w Curve corresponding to y-w Curve Fig.4
D
y-Zero profit line
Depth of water applied in Inches = W

P-W CURVES COMPUTED FROM Y'-W AND Y-W CURVES FIG.4

may be drawn through P_2 to the curve as shown on the *y'-w* curve in Fig. 4, thus showing that a solution would then be possible."

The last clause of this statement is incorrect, as should be readily apparent from the fact that the "tangent" referred to crosses the *y'-w* curve. A horizontal tangent to a curve does not necessarily indicate a maximum point on the curve. It may designate either a minimum or a maximum, or neither.

The situation in the present case may be illustrated by constructing a profit-water (*P-w*) curve, as in the accompanying diagram. The point of tangency to the *y'-w* curve in Fig. 4 corresponds to the flat place shown in the *P-w* curve at *A*.

It happens that the point chosen for P_2 in Fig. 4 is such that a tangent can be drawn through the point of inflection on the *y'-w* curve. If a slightly higher location had been chosen for P_2, then a tangent might have been drawn to either the convexed upward part or the convexed downward part of the *y'-w* curve, in which case the *P-w* curve would have been of the general form shown dotted in the diagram, the two tangents designating the *temporary* maximum and minimum points *B* and *C* respectively.

In the paragraph immediately preceding the sentence quoted above the authors state that when $\frac{b}{a}$ is less than *y* "it means that a profit may be obtained from dry-farming, which is contrary to the conditions considered in this case." This statement closes the matter and the discussion should have been carried no further.

It is believed that it would be much safer in all cases to find the peak of the profit-water curve by actually constructing that curve rather than by the indirect *y-w* curve method illustrated. This applies especially to complicated areas where many kinds of crops are to be grown.

It is mathematically demonstrated in the paper that the point of tangency shown on the *y-w* curve in Fig. 4 corresponds to a maximum point on the *P-w* curve, but this same fact is illustrated more clearly by the summit in the profit curve at *C*, in the accompanying diagram. The *P-w* curve also presents a picture of the actual profits, which the *y-w* curve-tangent method does not do. A maximum profit point located by the latter method for Case 2 or 3 without a proper understanding of the system may prove upon investigation to be a "minimum loss" point.

Denver, Colo., Oct. 11, 1923. JULIAN HINDS, Engineer, Bureau of Reclamation.

Composition Core-Walls Suggested by Apishapa Dam Failure

Sir—The failure of the Apishapa Dam in Colorado, described in *Engineering News-Record*, Sept. 13, 1923, p. 418, illustrates anew the hazards involved in the construction of earth-fill dams which have no special provision for preventing excessive percolation or flow of water through the dam. Sprinkling and rolling of the fill material may not always be sufficient to provide a reliable structure, and the factor of safety of such a dam may be lamentably low.

The logical way of obtaining a satisfactory structure is the application of what one engineer has called "the great hydraulic principle": Construct one impervious surface, and build the rest of the structure to support that surface. Accordingly, clay puddles, masonry and concrete core-walls, etc., have been successfully used for many earth dams. In a discussion of a paper on the design of earth dams (Proc. Am. Soc. C. E., Sept., 1923, p. 1616) the writer described a somewhat novel type of impervious diaphragm, or composition core-wall, which is in full accordance with the "hydraulic principle" and at the same time costs but little. This composition core-wall is made of two slabs of reinforced gunite with a layer of asphalt between, and it extends at a slope of about 1½ to 1 from the impervious foundation material to the crest of the dam. While it is desirable to place selected fine material against the diaphragm on the upstream side, the main portion of the fill may consist of ungraded material, and much less care than usual need be given in placing and rolling this material, inasmuch as the composition diaphragm is so flexible that it may be expected to adjust itself elastically to almost any settlement that may occur in an earth dam. Such composition core-walls should be built on an incline inasmuch as the material overlying the diaphragm will then always keep the asphaltum under compression. Furthern.ore, no forms are needed and the diaphragm may be conveniently built up without interfering with the work on the main fill. The upstream face of the dam should be protected against wave action by gravel, riprap, or a slab of reinforced gunite, preferably provided with weep-holes.

Inasmuch as the composition core-wall is buried in the body of the dam it is well protected against damage from temperature or other external influences, and it may be expected to last indefinitely. As regards impermeability of this type of core-wall, it is well known that gunite is remarkably watertight, and the layer of asphalt between the gunite slabs will give additional assurance against leakage. It is of importance, however, to secure a safe contact between more or less impervious foundation material and the core-wall both along the base of the dam and on the side abutments.

The water rising in the reservoir will first come in contact with the selected fine material overlying the diaphragm so that saturated clayey material, and not the water directly, will press against the diaphragm. This is obviously a great advantage as compared with a concrete slab on the upstream face of the dam, sometimes used.

For comparatively low embankments the composition core-wall may be made of two 1-in. slabs of gunite and one layer of asphalt. For higher structures two or more 2-in. slabs with a corresponding number of asphalt layers may be used. It is estimated that in average cases the cost of such composition core-walls will amount to about 40 to 50c. per square foot. The saving in placing the fill material, the reduced seepage losses through the dam, the protection against burrowing animals, and the greatly increased factor of safety of the dam should more than compensate for the cost of such a composition core-wall, and failures like those of the Apishapa Dam would be very unlikely to occur.

Los Angeles, Calif., Oct. 20. FRED A. NOETZLI, Structural and Hydraulic Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Dinner in Honor of Charles M. Schwab will be given Nov. 20 by the Engineers' Club of Philadelphia to which Mr. Schwab was elected an honorary member last June.

Contract for a Portion of the Baldwin water filtration plant, at Cleveland, Ohio, including filter and administration buildings and seven gate-house structures, has been awarded to the Strange-Walsh Construction Co., of Cleveland, at $2,885,500.

According to Recent Press Dispatches, the Pennsylvania R.R. plans to electrify a portion of its system over the Allegheny Mountains. The power for this electrification is to be developed at steam generating plants located at the coal mines. It is probable that the portion of the system referred to is the four-track main line between Johnstown and Altoona.

The Third Annual Ohio Conference on water purification with the Ohio Department of Health will be held at Columbus, Ohio, Nov. 21 to 24. Besides numerous papers and topical discussions visits will be made by automobile to see the water purification and softening plants at Newark, now nearing completion, and at Delaware, in service for a year.

Missouri Road Construction Progress is announced by the state highway department as follows: 2,032 miles of the 7,640-mile state highway system completed to Oct. 13 at an estimated cost of $25,284,000, of which 1,018 miles are graded earth, cost $7,096,000; 717 miles gravel, $6,384,000; 48.06 macadam and asphalt, $978,000; and 249 miles concrete and brick, $9,034,000. Bridge work and culverts have cost $1,792,000.

The Survey of the Power Resources of the valley of the Tennessee River, which is being conducted by the Corps of Engineers, will not have reached a point where reports on the Finch and Power Rivers will be ready for at least a year. This means that the Federal Power Commission will not be able to pass upon the application of the Knoxville Power & Light Co., the Tennessee Electric Power Co., and the Tennessee Hydro-electric Co., before that time.

The Secretary of War Has Requested an additional appropriation of $2,000,000 to cover the installation of four more units of electrical equipment at Muscle Shoals. The plan had been to install at first four 30,000-kw. generators. The structures are being built with the idea of accommodating eighteen units ultimately. The decision to install eight units at the start is thought to indicate confidence on the part of Secretary Weeks that a market will be found for a portion of the secondary as well as the primary power.

Railroad Construction Program to Be Continued in 1924

The enormous construction program of the railroads of this country which was started in 1923 will be continued in 1924, according to an announcement of the American Railway Association. The total expenditures for this year will amount to $1,059,440,000 and the unexpended balance appropriated for new work which will be carried over into 1924 amounts to $243,804,000, which, with the $429,273,000 spent in 1922, makes a grand total of $1,732,517,000 spent in capital improvements since the railroads started their reconstruction and extension work in 1922.

Canal Bureau Investigation Ends

Judge Joseph A. Kellogg, appointed by Governor Smith to conduct an investigation into the canal bureau of the state department of public works under the Moreland act, has ended his investigation and is engaged in the preparation of a final report which will be submitted to the Governor soon after Nov. 20.

Royal K. Fuller, deputy superintendent of public works, in charge of the bureau of canals and waterways, is said to be in favor of the abolition of the office of division engineer and the undertaking of all dredging operations by contract. Mr. Fuller favors bringing the entire barge canal system to a mean depth of 12 ft. and undertaking dredging in the spring to bring this about.

Observers of the situation look for a general shakeup in the personnel of the barge canal force at an early date.

How Bureau of Reclamation Is Reorganized

Detail announcement of the changes in the Bureau of Reclamation briefly announced last week (p. 777) sets forth the complete separation of engineering and project operation, the latter including settlement of the projects. The field commissioner of the bureau is to be in charge of operation, including water service, collection, settlement and development problems. Project managers will report to the field commissioner on these matters and to the chief engineer on engineering matters. The engineering department is restricted to the investigation of proposed projects, the designing of irrigation works, and their construction. Both the field commissioner and the chief engineer are to be subordinate to the commissioner of reclamation. Minor departmental changes in the Washington office are also ordered, which, the announcement of the Interior Department says, "make a net saving of $10,000 a year on salaries alone." The reorganization of the field service is to become effective Jan. 1.

Many Bond Issues Voted Upon November 6

Pennsylvania Roads Get $50,000,000—Virginia Rejects $50,000,000 Issue—Other Projects

Bond issues for public improvements and constitutional amendments proposed to facilitate public works construction were not surprisingly extensive as recorded by voters throughout the country at the general elections held Nov. 6. Decided antipathy to raising the debt limit or to increasing bonded indebtedness was apparent in some sections of the country, while in others large issues were authorized or municipalities were empowered to extend debt limits in order to provide for increased sewerage, water-works and general municipal facilities, or provide for street and road work and public buildings and bridges.

The State of Pennsylvania authorized, by an amendment to the state constitution, an increase of $50,000,000 in the amount the state assembly is empowered to appropriate for road-building purposes. The money will be available only after the assembly provides for the issuance of bonds, and they are sold. As the next session of the assembly does not convene until January, 1925, the $50,000,000 will not become available until the construction season of that year. The amendment was approved by a vote of about four to one.

The only other large state highway issue voted upon, one of $50,000,000 proposed for the completion of Virginia's primary highway system, was overwhelmingly repudiated by the voters of that state.

Philadelphia Loan Approved

Voters of Philadelphia approved the municipal loan of $67,250,000, to be provided in 50-year bonds, the money to become available after the city council has passed enabling acts for each specific appropriation. The largest items in this loan are: Delaware River bridge, $5,623,000; sewage-disposal plants, $9,000,000; water supply, $6,000,000; sewers, $3,300,000; high-speed subway, $15,000,000; surface car subway, $10,000,000; damages for street openings, $5,077,000; and port development and art museum, $2,000,000 each. Although most of this money will not be available until March, 1924, construction of the Delaware River bridge can be carried forward on the basis of funds authorized as soon as enabling acts can be provided by the city council.

Philadelphia also authorized a municipal loan of $3,750,000 of 15-year bonds for road improvement in the city, police signal equipment, improvement of the county institution for the feeble-minded and the construction of a surface car line. Road improvement will take about $2,400,000 of the total, and the money will be available about March 1, 1924.

Voters of Chicago authorized the city to levy an additional 25c. per $100 of assessed property value for school construction and the acquisition of school sites; (2) to issue bonds in the sum of $2,650,000 for constructing the proposed La Salle St. bridge; and (3) to issue $2,000,000 in bonds for establishing, enlarging and improving parks and boulevards under control of the West Chicago Park Commissioners. The tax for school purposes, it is believed, will raise in the neighborhood of $4,250,000 yearly.

Baltimore was authorized to issue $10,000,000 in stock of the municipal corporation for water-works improvements. Work will consist largely in extending mains into new territory, and in the purchase of private plants within the city limits. It is planned to use $2,000,000 of the money each of the next five years, and sale of the first issue is expected to take place within 90 days. Baltimore was also authorized to provide $1,000,000 for new police department buildings.

Cincinnati Repudiates Issues

Cincinnati was one city wherein bond issues for public improvement were overwhelmingly defeated. The five issues proposed, but against which at least five to three votes were returned, were: widening and extending Fifth St., $1,850,000; city's share of bonds for Eighth St. viaduct, $850,000; sewer extensions, $650,000; park system, $1,750,000; and Canal Boulevard, $3,300,000. Hamilton County, Ohio, also defeated $2,500,000 proposed public library bonds.

It is also interesting to note that the voters of Cincinnati rejected a proposed city ordinance to limit the speed of motor-driven vehicles by the installation of automatic governors. It was proposed to install and seal speed-regulating devices to hold vehicles to a 25-mile maximum.

A bond issue of $5,000,000 for a sewage disposal plant and necessary relief, storm water and interceptor sewers was passed by the city of Grand Rapids, Mich. Sewer construction to the amount of about $800,000 will be undertaken in 1924. The disposal plant will probably not be started until 1925.

Two amendments to the city charter of Detroit provide money for public improvements. The first raises the city's bonding limit from 6 to 9 per cent, and provides for the issuance of bonds as follows: water-works, 2 per cent of all real and personal property in the city; electric light and power, 1 per cent; other public utilities, 2 per cent; all other lawful purposes, 4 per cent; the total not to exceed 9 per cent. This bonding limit amendment, which required a 60 per cent favorable vote, received 62 per cent.

What is considered more important was the Detroit charter amendment which paves the way for rapid transit by allowing the city to bond up to 4 per cent of its assessed valuation for such purposes. This proposition also required a 60 per cent favorable vote, but received one of 67 per cent. The city is given authority to proceed with plans for the construction of a rapid-transit system. On the basis of the present valuation of the city's property $80,000,000 may be so issued. The amendment also provided for a subway board of three members each to receive a salary of not less than $10,000 yearly.

Another important construction project which was considered Nov. 6 was a proposition set before the voters of Toledo, Ohio, whereby $3,000,000 in bonds was to be used for grade elimination work. Though the measure received a large majority of favorable votes it was lost through failure to receive a two-thirds vote. However, it is probable that inasmuch as the electorate returned a majority in favor of grade elimination the work will be done through other means.

Several bond issues for road and bridge construction and others for building schools, were reported. In Oregon bridges are provided as follows: Sellwood bridge (near Portland), $350,000; Albany bridge, $294,976; and Harrisburg bridge, $203,592. All will span the Willamette River, the latter two at the the towns named.

Voters of Somerset County, Pa., approved a $2,000,000 road bond issue.

Other bond issues voted favorably on were: Charlottesville, West Va., $500,000 for water-works; McKeesport, Pa., $233,000 and Jamestown, N. Y., $280,000 for water-works; Massillon, Ohio, $300,000 for sewers; Warren, Ohio, $926,000 for schools; Youngstown, Ohio, $1,000,000 for schools; and Buffalo, $1,000,000 for a natural science museum.

Will Buy Distribution System of Montclair Water Co.

On Nov. 6 the town of Montclair, N. J., voted to buy the distribution system and other local property of the Montclair Water Co., or if that cannot be done then to build a distribution system. The vote to purchase was 3,860 to 1,852, and the vote to build a new distribution system, if need be, stood 1,467 to 4,483. The corresponding majorities were 1,852 and 3,016.

Prior to the election it was announced that the Montclair Water Co. had offered to sell all its property within Montclair, used for local supply purposes, for $1,700,000, retaining its share in the Little Falls pumping and filter plant and the other property owned jointly by the East Jersey Water Co. and associated companies. It was also announced that Montclair had applied to the North Jersey District Water Supply Commission for a right to 3 m.g.d. in the Wanaque supply being developed by the commission under a contract with Newark, and that the Newark authorities had agreed to exchange this water right for the same quantity of Pequannock water, and that pending the completion of the Wanaque works, some three years hence, Newark would sell Pequannock water to Montclair at $90 per m.g. The expectation is that the purchase of the distribution system will be consummated at an early day and that immediately thereafter a connection will be made with the Newark-Pequannock conduit.

By means of these contracts and changes Montclair will effect a change from the filtered Passaic River to which there has been increasingly strong local objection during the past few years. A feature of the campaign against this supply was the B. Welchii incident, treated at length in these columns.

Scores Injured as Two Temporary Grandstands Collapse

Fifty-eight spectators at a football game between West Virginia and Washington and Lee were injured, though none fatally, in the collapse of a temporary grandstand Nov. 10 in Charleston, W. Va. A score or more were hurt when a like accident occurred at Lewisburg, Pa., during the Lehigh-Bucknell game.

The accident at Charleston occurred when the spectators arose during an exciting moment when the home team was scoring at the far end of the field. The spectators had been seated about an hour. Most of the injuries received consisted in broken legs and sprains. These temporary stands were 200 ft. long and 12 ft. high at the rear and contained seating arrangement for approximately a thousand. Inspection of the stands by a local engineer indicated cross-bracing on the rear of the stands was lacking. No official investigation has been started.

No details on the description of the Lewisburg stand are available at present.

U. S. Senate Committee Views Chicago Projects

Sewage disposal and waterway projects of Chicago and Illinois are being studied by a committee of the U. S. Senate, largely in regard to the city's desire to increase its diversion of water from Lake Michigan to 10,000 cu.ft. per second for the purpose of diluting the sewage flow in the drainage canal. A secondary matter is the establishment of a 9-ft. navigable channel from Lake Michigan to the Mississippi. The drainage canal is 24 ft. deep and the state has started a 9-ft. connection to the Illinois River at La Salle, but the improvement of that river to the Mississippi must be done by the federal government.

At one of the meetings it was stated that the Sanitary District of Chicago has spent $125,000,000 on sewage disposal works and plans an expenditure of $97,000,000 within the next twenty-two years to provide for the increasing population. The city's entire program of sewage treatment and disposal is based on the claim that the city has a right to divert a flow of 10,000 cu.ft. per second from Lake Michigan.

French Firm Gets Contract for Port of Athens Work

The contract for the Piraeus Harbor works has been awarded to a French syndicate. The contract involves the expenditure of 200,000,000 drachmas, based on a rate of exchange of 400 to the pound sterling, any difference above or below this to be adjusted in bi-monthly settlements.

The conditions accepted are: 17 per cent compensation of the value of machinery and installations erected for the purpose of the works; 14 per cent for overhead expenses; and 10 per cent profit. Work is to begin this month and is to extend over a period of not more than 8 years. The tender accepted follows generally the specifications drawn by the port committee. There was only one other offer received, from a French-Dutch-Greek group. No American or British offer was received.

Omaha Water Emergency Is Investigated

Report Made on Inquiry Into Cause of Breakdown of Sedimentation Process Last August

Special Correspondence

An unfortunate combination of circumstances apparently was to blame for the emergency by which the water mains of Omaha were filled with mud during the week of Aug. 21. An open investigation was held, starting Oct. 23, by the directors of the Metropolitan Utilities District to ascertain what happened and why. (See *Engineering News-Record*, Aug. 30, p. 364.) Reports were made by C. D. Robison, engineer in charge of operations; R. B. Howell, general manager; F. P. Larmon, chief engineer in charge of construction; George T. Prince, consulting engineer and formerlv chief engineer; and A. B. Hunt, superintendent of the Florence station and for forty-three years an employee of the water-works.

Mr. Robison's conclusions as to the cause of the breakdown of the sedimentation process through the series of seven reservoirs on which Omaha had depended to get a reasonably clear water, are as follows: (1) Failure to complete the installation of pumps authorized in June, 1922, before the maximum demand in 1923; (2) failure of the operating department to recognize the emergency in time and to use to the utmost the pumping capacity available to wash and fill the basins; (3) a river water of unusually high turbidity (20,000 p.p.m. was reported) at peak demand; (4) an open mud valve which increased the low-service pumpage by more than 2 m.g.d. and made less water available for basin washing and refilling; (5) a broken valve in a bypass around Basin 2 made it impossible to clean this basin until the demand was reduced or the influent from Basin 3 to the new filter plant was completed.

Principal Reason Given

Mr. Prince stated that the prime reason for the breakdown of the basin service was the lack of regularity in washing the settling basins. In his opinion the operating department did not fully realize the seriousness of the situation and allowed their fear of the possible breakdown of the machinery to deter them from maintaining the required pumpage into the basins and the proper washing of them. The river water carried about five times as much turbidity as in corresponding months of previous years. Connecting the filter plant with the existing system interfered with the normal operation only seven days and Mr. Larmon stated that there was ample time (nearly two weeks) after the last interference and before the emergency, for the reservoirs to be cleaned.

Mr. Larmon concluded that the fundamental cause of the breakdown of the sedimentation system was the lack of sufficient pumping equipment to permit washing the basins often enough to cope with the large amount of silt carried by the river.

Mr. Hunt also stated that the principal cause of the breakdown was the delay in ordering new pumps, breakdowns in the old ones for the past two or three years seriously interfering with basin washing, but he cited eight local contributing causes culminating when the river started to cut into a mud bank just above the intake.

The report of the investigating committee found that there was excess pumping capacity not used; that against the orders of the chief engineer a basin with unstable walls was filled and the wall collapsed losing 10 to 15 m.g.d. of water and putting the basin out of service 18 days; that the chemists' requests for basin cleaning were ignored; and, that a mud valve was opened wasting 12 m.g.d. (no one knows by whom). The committee was of the opinion that better operating records should be kept so that those in charge would be advised at all times as to turbidity, necessity of washing and of construction under way but that operation should always be the first consideration.

San Francisco to Have Vehicular Tube Under Market Street

Contract has been awarded by the California State Harbor Commission for a vehicular subway under the Market Street car loops at the Ferry. The tube has been planned to provide a means by which traffic moving along the waterfront can cross the heavy Market Street traffic without delay. The cost of the tube is to be apportioned as follows: Harbor Commission, five-eighths; City of San Francisco, one-quarter; Municipal Ry., one-eighth. Until the franchise of the Market Street Ry. expires, that company will pay 6 per cent interest on one-eighth of the cost.

The tunnel proper will be 330 ft. long, with a 330-ft. approach on a 4 per cent grade at either end. The clear width will be 23 ft. and the height 13 ft. Construction is to begin at once and is to be completed in about ten months. The contract went to the Tibbitts Pacific Co. for $237,700, and the total cost of the tube including cement, sump pumps, etc., is estimated at about $330,000.

N. Y. Building Congress Prepares Interesting Program

A program of luncheon meetings for members and friends of the New York Building Congress has been announced. The first will be held Nov. 21, the subject to be winter construction, and special reference will be paid to advantages of winter construction to public departments, real estate interests, property owners, architects, builders, workmen, and material dealers. The January meeting will be addressed by Charles L. Eidlitz, commissioner of the Electrical Contractors Association, on "What the Law Writes into Your Building Contract." Other meetings have been arranged as follows:

February, simplified practice, with special reference to how simplification can be applied to the advantage of the building industry; March, the building congress movement, and what it has done for all elements of the building industry; April, an illustrated lecture on the Japanese disaster; May, an international review of the contribution of organized labor to the building industry; and June, three centuries of American architecture, also an illustrated lecture.

Walsh Resigns as Head of N. Y. Canals Bureau

Greene Appoints Royal K. Fuller, Former Highway Commission Secretary, to Succeed Him

Edward S. Walsh, Commissioner of Canals and Waterways of the New York State Department of Public Works, twice superintendent of public works under Democratic administration, resigned Nov. 9, the resignation becoming effective Nov. 12. When the law combining the state departments of highways and public works and public buildings became effective, Mr. Walsh was temporary head of the combined departments which bore the title of State Superintendent of Public Works. Commissioner Greene was named by Governor Smith as State Superintendent of Public Works which relegated Mr. Walsh as head of the Bureau of Canals and Waterways.

Upon assuming his new office Colonel Greene instituted an investigation of the public works department, beginning with the canal bureau of which Mr. Walsh was the head.

In a statement to the press concerning his resignation, Mr. Walsh said: "In presenting my resignation as Commissioner of Canals and Waterways to the Superintendent of Public Works, I do so with the full knowledge and belief that I am acting in the best interests of the proposed plan of consolidation of the public works department having to do only with the canal system of this state.

"Not in sympathy with the consolidation act that subordinates the old Department of Public Works to a mere bureau known as the Bureau of Canals, feeling that when that section relating to the maintenance and operation of the canal system of the state was written into the constitution it was not contemplated nor intended that at any time in the future the canals would occupy a secondary place in the consolidation or concentration of state activities, I am confident that the step I am now taking is the proper one."

Colonel Greene has announced the appointment of Royal K. Fuller of Albany, as Commissioner of Canals and Waterways, to succeed Mr. Walsh, resigned.

Mr. Fuller, who was formerly a New York newspaper man, entered the state service in 1913 as secretary of the State Highway Commission. He served as secretary of the Highway Commission in 1913 and 1914 and was reappointed by Colonel Greene in 1919.

Since 1921 Mr. Fuller has been with the firm of Fuller & O'Brien in Albany. This firm has been engaged in the insurance and surety bond business, specializing on highway contract work.

Parkway Tunnel in Philadelphia Under Contract

The Commissioners of Fairmount Park in Philadelphia, on Oct. 31, awarded a contract to Andrew O'Neill, Philadelphia, for construction of three sections of the surface car tunnel under the Parkway. The contract price is $166,000. The work includes construction of the portion of the tunnel directly beneath the Parkway roadway, and will permit of completion of the roadway at this point.

Rail Bridge and Building Men Meet

Prominent subjects at the annual convention of the American Railway Bridge and Building Association, held at Seattle, Wash., in October, included the advantages and disadvantages of concrete tanks, a comparison of culvert materials, renewals of ballasted-deck timber trestles and the methods of installing culverts under traffic.

In a paper on "Concrete Tanks for Railway Water Service," C. R. Knowles, engineer of water service, Illinois Central R.R., stated that watertight concrete can be made but that there is need for uniform or standard designs of tanks to reduce the cost, as at present the first cost does not compare favorably with other materials. Both concrete pipe and cast-iron pipe for culverts were approved in a committee report, the selection being governed largely by local conditions. There is said to be a tendency towards the use of concrete pipe on account of lower cost of installation. That ballasted-deck timber trestles under repair are usually found in worse condition than indicated by the inspector's report, was stated in a committee report which also described different methods of carrying out renewals of ballasted decks. Another report presented various methods of installing and renewing culverts and pipe lines in railway fills under traffic by means of tunneling and trenching and by jacketing or jetting pipes horizontally through the solid fill.

A uniform painting program covering the entire year and enabling a permanent force to be maintained is practicable and economical, according to a committee report, and the arrangement of such a program was presented in a paper by T. R. Wyles, vice president of the Detroit Graphite Co. Detailed lists of tool equipment for bridge and building gangs and water service gangs were presented by another committee, together with notes of special equipment for the latter gangs. Other reports dealt with water facilities at stock yards and the heating of small passenger stations. The organization and management of railway bridge and building forces was the subject of a paper by George W. Rear, bridge engineer, Southern Pacific Ry.

Addresses on general railway matters included "Railways as Investments," by G. T. Reid, vice president of the Northern Pacific Ry., and "Relations of Railway Employees to the Public" by M. Nicholson, general manager of the Chicago, Milwaukee & St. Paul Ry. The new president is J. S. Robinson, division engineer, Chicago & Northwestern Ry.; C. A. Lichty, Chicago & Northwestern Ry., Chicago, was re-elected secretary.

St. Louis' Legal Right to Build Auditorium Upheld

A taxpayer's injunction suit to prevent the City of St. Louis from issuing $5,000,000 of bonds for a municipal auditorium has been dismissed by a circuit court judge on demurrer by the city attorney. The judge holds that general powers of the city under its charter are broad enough to enable it to issue the bonds. He also states that courts of appeal have been almost unanimous in upholding the rights of cities to build municipal auditoriums.

Another Chicago Subway Plan

Of the many projects for subways in Chicago the latest is a simple one to relieve the extreme congestion of street traffic in the business district by removing from the surface the cars that come in from the west, southwest and northwest sections of the city. Since some of these car lines already use the tunnels under the Chicago River at Van Buren St., Washington St. and La Salle St., it is proposed to connect the first two tunnels by a U-shaped subway having its loop under Grant Park, at the lake front, and having a branch to the La Salle St. tunnel. This plan, suggested by R. F. Kelker, consulting engineer, could be extended later.

Pontoon Bridge Not Suitable

Washington Correspondence

Exceptions have been taken by the Secretary of War and the Chief of Engineers to published statements indicating that they allowed red tape to interfere with the relief of the situation caused by the burning of the North-End Bridge at Springfield, Mass. (See *Engineering News-Record*, Oct. 4, 1923, p. 540.) Their side of the matter is that Springfield interests did not want pontoon bridges after they were acquainted with the fact that the transportation cost on the nearest pontoons available would amount to $53,000. They also had lost sight of the fact that a pontoon bridge is a one-way structure, and that two bridges would have been necessary. On being acquainted with these facts, the local interests decided that relief in that term was not desirable.

Agricultural Engineers Hold Chicago Meeting

Sectional meetings were the main feature of the annual convention of the American Society of Agricultural Engineers, held at Chicago on Nov. 8 to 10, the three general sessions being short and for the presentation of addresses. The farm structures section had papers on the structural design, ventilating and heating of farm buildings; also "Fire Resistive Construction for Timber Buildings," by T. F. Laist, National Lumber Manufacturers Association, and "Sewage Disposal Projects," by H. B. Walker, professor of agricultural engineering at Kansas State Agricultural College.

Tile drainage, soil erosion and land clearing were the principal subjects discussed by the reclamation section, the papers including "Drainage Investigations," by L. L. Hidinger of the Morgan Engineering Co., and "American Irrigation Since 1900," by Samuel Fortier, U. S. Department of Agriculture. Features of education in agricultural engineering constituted the program of the college section. Other groups of papers were considered by the farm power and machinery section and the rural electrification section.

Officers for 1924 are as follows: President, S. H. McCrory, chief of division of agricultural engineering, U. S. Department of Agriculture; vice-presidents, L. J. Fletcher and E. R. Jones, professors of agricultural engineering at the University of California and University of Wisconsin, respectively; secretary and treasurer, Raymond Olney, Mount Clemens, Mich.

Random Lines

Leaky Valves?

For Sale: Silica Sand Plant and Quarry. Immediate sale necessitated by ill health of Prime Mover—From *Engineering News-Record* advertising pages.

* * *

A Bolshevik Distinction

Lenin's argument was that Revolutionists must no longer be mere enthusiasts, idealists, and dilettantes; they must become professionals, "revolutionary engineers." . . . He wrote: "I trust that our champions will accept this technical word 'engineers' for when I speak of inadequate preparation I reproach myself. . . . The Revolutionists must not be degraded into the amateur." — From an article in *Die Neue Rundschau*, translated in *The Living Age*, entitled "Lenin, Revolutionary Engineer."

This should be a refreshing distinction to those controversalists who are not yet persuaded that engineering is a profession.

* * *

No Life of Ease

Sir—In this column of Oct. 18, 1923, I find "motion picture engineers" listed with the "moving engineers" and other pseudo-professional men. This is so manifestly unjust that I cannot let it pass. During the past year we have built short railroads where there was no excuse for a road, on the side of a wild gorge, taken a locomotive in (in pieces), set it up, and wrecked it in the same gorge. How would the average practising engineer like to get and how would he meet the following request: "Wanted—a practical set showing the side of an ocean liner, from water to top of stack; foreground to be water, with wave action, and liner to sink in same, tilting as it sinks to match stock film of sinking liner." Another request was for plans for a method of producing in "practical" earth, a suddenly appearing crack.

The art director wants a "visible" chart giving him the horizontal and vertical angles of all the lenses in use in the studio, so he will know the space required for his sets in advance, and his camera distances. The property man brings in a photograph of an existing dam and power house, and wants drawings of same, so he can build a scale model of it. He also wants to know the best method of arranging the construction of the model, so it can be blown up, and release an apparently large body of water. Add to all this the rejuvenation of old bridges, so as to be "practical," and their immediate re-aging so they will fall, and you will see that some engineering knowledge and ingenuity is required.

Those of your readers who imagine that we spend our time with peroxide blondes, and he-dolls with shellacked hair, are sadly mistaken, as badly mistaken as the misguided flappers who think motion pictures mean a life of ease. The hours are long, the work is often at high pressure to save the time of a large and expensive cast, and the engineers see little of actual production, except when their presence is required for engineering effects.

"One of Them"

Highway Research Board Reviews Progress

Technical Committees Report—Activities Hampered by Lack of Funds

Engineering News-Record Staff Report

Co-ordination of highway research has made substantial progress in the last twelve months, as indicated by the reports of committees at the meeting of the Advisory Board on Highway Research of the National Research Council held in Washington, D. C., Nov. 8 and 9. About 60 research engineers and engineers interested in highway engineering and highway transport attended the three sessions and inspected the experimental work of the U. S. Bureau of Public Roads at Arlington, Va. Six committees on economic theory, structural design, road materials, finance, traffic and maintenance made formal reports and there were separate papers and sub-committee reports on rubber tires, mechanics of slabs, objectives of research, research by land grant colleges, research in North Carolina and motor vehicle performance.

The resignation of Prof. W. K. Hatt as director of the Board owing to his return to Purdue University was noted and the announcement made that E. R. Olbrich, construction engineer of the North Carolina Highway Commission, had been appointed technical assistant to the director. The appointment of a new director lies with the executive committee and will be made soon. Three bulletins have been published during the year. All work however has been hampered by lack of funds.

The by-laws of the Advisory Board provide for a committee on ways and means which has been appointed but has been inactive.

Funds Lacking

Shortly after the formation of the Advisory Board, Vice-Chairman Flinn planned to circularize a number of prospective contributors to the financial budget but the policy of the Board in respect to this matter was not settled. It appeared wise afterward to look to official sources such as state highway commissions and federal organizations for main support. While the Connecticut Highway Commission aided the Board with an appropriation for a period of two years, the desire of other commissions to take similar action was checked by legal barriers.

At the suggestion of the director contributions of money and equipment have been made by industries to research projects that were languishing and to which the Advisory Board was asked to give assistance. In such cases the funds are not handled by the Advisory Board. The only responsibility the director takes is in a matter of judgment as to the probable successful management of the research.

A field of work demanding direct expenditure of the funds of the Board is in holding conferences of research workers for the purpose of agreement on objectives of research and upon boundaries of fields of action. This fruitful service together with the expenses attending meetings of the research committees, can be extended if funds were available.

The present income is only sufficient to pay the salary and traveling expenses of the director, and publication.

Following the reports from committes and special papers a technical summary of which will appear in the next issue the delegates re-elected A. N. Johnson as chairman and A. D. Flinn as vice-chairman of the Board for the coming year.

Wickenden to Administer Fund for Educational Study

William E. Wickenden, assistant vice-president of the American Telephone & Telegraph Co., has been chosen director of the committee which is charged with administering the $108,000 fund provided by the Carnegie Corp. for a "discriminating study of the present status of engineering education." Award of the money to carry out research conceived by the Society for the Promotion of Engineering Education was noted in these columns last week.

Mr. Wickenden is a native of Toledo, Ohio, and a scientific graduate of Denison University, which institution he left in 1904. After a year's teaching in Rochester he was a graduate student in physics and electrical engineering from 1905 to 1907 at the University of Wisconsin, later becoming an instructor in the same institution. In 1909 he was appointed assistant professor of electrical engineering at the Massachusetts Institute of Technology, being made associate professor in 1914. He remained at that institution until 1918.

In 1917 he made a study of educational and personnel problems for the engineering department of the Western Electric Co., research which led to the creation of a personnel department, of which he became manager in 1918. During that year he also served as regional supervisor of personnel methods for the Students' Army Training Corps. In 1921 he was transferred to the headquarters staff of the American Telephone & Telegraph Co. as assistant vice-president in charge of the recruiting and development of supervisory and technical personnel for the group of companies which comprise the Bell system. This work included the promotion of relations with universities and colleges throughout the country and supervision of the recruiting and introduction to the telephone business of approximately 2,500 graduates of engineering colleges.

Mr. Wickenden has written considerably for the technical press, his writings relating principally to illuminating and power plant engineering and to personnel problems in industry. He is chairman of the education committee of the American Institute of Electrical Engineers and chairman of the committee on relations with engineering colleges of the American Management Association. He was recently chairman of the committee on business training of the Society for the Promotion of Engineering Education.

Mr. Wickenden's home is in Upper Montclair, N. J.

Railroads Make New Records; Plan Increased Efficiency

Peak Load Past—More Freight Handled Than in Any Previous Period—Program for Next Year

As a result of the ambitious plans made by the railroad companies last Spring to meet the demand for improvements in the transportation services, the greatest peak load season in their history has been passed successfully. The effort has resulted in setting up the following efficient records:

(1) They have put into service 14,636 new freight cars and 2,963 locomotives, a larger number than in any similar period in the last decade; (2) a larger number of cars and locomotives have been repaired and put in serviceable condition than in any equal period. The percentage of locomotives in disrepair on Oct. 1 was the lowest in the history of the railroads; (3) more freight business was handled between Jan. 1 and Oct. 20 than in any corresponding period in history. The number of cars loaded with revenue freight in that period was 40,545,920, representing an increase of 10 per cent over the total for 1920, the previous record; (4) the average mileage a day attained by all the freight cars throughout the country in the first nine months was 27.6, and in September reached 29.2. This compares with 22.5 miles for the first nine months of 1922; (5) a record-breaking business was handled without congestion, and with practically no embargoes or car shortages; (6) the amount of freight service rendered with each car was 511 tons carried one mile daily, which surpasses the mark of a year ago by 31 per cent; (7) from Jan. 1 to Oct. 1 23,268,635 tons of coal were dumped at Lake Erie ports for movement by boat to the Northwest; (8) a greater amount of railroad coal has been placed in stock-pile storage than was ever heretofore stored by the railroads.

Announce a New Program

In order to continue the work of the past year and to make further improvements the American Railway Association has announced the following program for next year:

(1) That there be a continuation of the intensive efforts of the railroads to reduce the percentage of locomotives and cars awaiting repair, and maintain it at the lowest possible minimum consistent with the volume of business offered and the revenues which the railroads are permitted to earn; (2) that there be increased supervision on the part of the railroads and greater co-operation with shippers to bring about better utilization of car capacity; (3) that there be continued the intensive effort to increase the average daily movement of freight per freight car and an endeavor to make new records of achievement in the prompt movement of traffic; (4) continued study and consideration of the possibility of the greater joint use of facilities; (5) that there be a continuation of the complete co-operation of the railroads in carrying out the directions of the car service division of the American Railway Association; (6) that active support be given by the railroads to all phases of the work of the regional shippers' advisory boards that have been organized by the public.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES. Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The California Section of the American Water Works Association held its fourth annual meeting at Fresno, Oct. 25-27, with an attendance of 150.

The Indiana Section of the American Society of Civil Engineers was recently organized, at Indianapolis. Presentation of the charter was made by John H. Dunlap, secretary of the American Society of Civil Engineers, who is making an organization tour of the Middle West and Pacific Coast states in the interest of the society. Mr. Dunlap gave an outline of the work of the national and state organizations. The meeting was attended by twenty members. Lawrence V. Sheridan is temporary chairman. Permanent officers will be elected at a later meeting.

Personal Notes

COL. THEODORE A. LEISEN, consulting engineer in charge of the construction of the 320-m.g.d. filtration plant at Detroit, Mich., has been made general manager of the Metropolitan Utilities District of Omaha, Neb., replacing R. B. Howell, who has resigned to take up his duties as United States Senator from Nebraska. Prior to his service in Detroit, Col. Leisen was chief engineer and superintendent of the water departments of Wilmington, Del., and Louisville, Ky., and consulting engineer of the water company of Frankfort, Ky. In 1919 he was commissioned Major, Q.M.C., and had charge of the construction work at Camp Custer, Mich., later becoming lieutenant-colonel of the Reserve Corps. He is a past-president of the American Water Works Association. In Omaha he will take up the problem of the city's water supply.

E. R. OLBRICH, construction engineer, North Carolina State Highway Commission, has resigned to become assistant director of the Advisory Highway Research Board of the National Research Council with headquarters at Washington, D. C.

WALTER G. KIRKPATRICK, consulting engineer, Birmingham, Ala., has accepted a professorship of engineering in the University of Mississippi, of which he is an alumnus. Mr. Kirkpatrick was formerly city engineer of Birmingham, Ala., and had served in the same capacity in Jackson and Monroe, Ala. He was for a time special engineer for the Alabama Power Co.

MAXWELL V. SAUER has resigned as hydraulic engineer of design of the Hydro-Electric Power Commission of Ontario, Canada, to become hydraulic engineer of Canadian Vickers, Ltd., at Toronto, and consulting engineer to Vickers, Ltd., of England. After graduation from the engineering department of the University of Toronto, Mr. Sauer was with the Ontario Power Co. at Niagara Falls, as assistant to the mechanical engineer, then for a year he was chief designer for the Niagara Falls Power Co., Niagara Falls, N. Y., returning to the Ontario Power Co. as mechanical engineer. From 1913 for five years, as engineer of design for the Greater Winnipeg Water District, he was engaged in the construction of the Shoal Lake aqueduct and appurtenant structures, including a 100-mile railroad.

ALLISON H. BAER, who has been field secretary of the Associated General Contractors for a year, recently resigned to become secretary-treasurer for the Hitchcock-Tinkler Construction Co., which has been awarded the Moffat tunnel construction job at Denver. The new field secretary of the A. G. C. is WILFRED J. COLSON, who has been secretary of the Builders' Exchange of Worcester, Mass.

IVAN E. HOUK has resigned as city engineer of Dayton, Ohio, and has accepted a position as engineer with the U. S. Bureau of Reclamation. Mr. Houk will be stationed perhaps permanently in the Denver office and expects to be engaged on research work and hydraulic problems. He has had extensive experience in hydraulic investigation. In October, 1911 he became associated with the Morgan Engineering Co. of Memphis, Tenn., serving two years on hydraulic measurements and studies and the design of reclamation works and drainage structures in the lower Mississippi Valley. In 1913 he was made assistant engineer on flood prevention surveys and studies, being located at Dayton, Ohio, and was in charge of stream-flow measurements, investigations and hydraulic studies. Prior to his becoming city engineer of Dayton he was assistant engineer on Miami Conservancy District work.

LESLIE H. ALLEN has become associated with Russell B. Williamson, architect, Milwaukee, Wis., as partner and business manager. Mr. Allen has for the past two years been in charge of the Concrete House Division of the Portland Cement Association, and prior to that was for two years with Fred T. Ley & Co., New York, and for eleven years with Aberthaw Construction Co.

RALPH BEEBEE, city harbor engineer of Oakland, Calif., has resigned to accept the position of chief engineer with the Berkeley Waterfront Co. which plans extensive wharf improvements along the South Berkeley bay shore. HARRY HESS, assistant city harbor engineer, has been appointed to fill the vacancy temporarily.

PROF. VLADIMIR KARAPETOFF of the School of Electrical Engineering, Cornell University, has been awarded a prize of four thousand francs by the Montefiore Foundation of the University of Liege, Belgium, for his kinematic computing devices for representing complicated electrical relationships. In his experiments Prof. Karapetoff had the assistance of funds supplied to Cornell University by August Heckscher.

GEORGE J. CALDER, former resident engineer on construction of the filtration plant at Sacramento, Calif., and now construction engineer for the new Carquinez highway bridge across the straits, between Solano and Contra Costa Counties, has opened consulting offices at 1010½ Eighth Street, Sacramento, Calif., with M. W. SAHLBERG, junior partner, in charge. Both are civil engineering graduates of the University of California.

Obituary

B. J. DALTON, who was chairman of the valuation committee of the Missouri-Kansas-Texas R.R. lines from 1916 to 1920, died at the Ka y Hospital, Parsons, Kan., Oct. 28, aged 58 years. Mr. Dalton was a native of Franklin, Ky., and a graduate of the University of Kansas engineering school. For a time he was chief engineer of the Kansas, Oklahoma Central & Southwestern Ry. which was later absorbed by the Santa Fe system for which he became a resident engineer. Later he was chief engineer of the Denver, Enid & Gulf Ry. Previously he had served for two years as city engineer of Lawrence, Kan., and in 1906 he became professor of railway engineering at the University of Kansas. Prior to 1916 he was assistant district engineer of the Bureau of Valuation of the Interstate Commerce Commission.

COL. HENRY S. HAINES, retired railroad civil engineer and for many years connected with and at one time vice-president of the Plant System of railroads in the South, died at Lenox, Mass., Nov. 2, aged 86 years. Colonel Haines was born in Nantucket, Mass., educated in Savannah, Ga., and served in the Civil War as chief of transportation engineers. He advised the government of India on its change of railroad gage and was chief consulting engineer for the City of Paris on the increase of its water supply. He was the author of several standard works on American railroad management. He was a past president of the American Society of Civil Engineers and the American Society of Mechanical Engineers and of the American Railway Guild.

CHARLES M. CUNLIFF, superintendent of construction for the division of parks and recreation, St. Louis, Mo., died in that city Nov. 2, at the age of 32 years. Mr. Cunliff served in the engineering department of the Zoological Board of Control of St. Louis for four years, building the cliff bear pits in Forest Park and the Zoo Lakes. He served at the officers' training camp at Salt Lake City during the War, having enlisted in the 32nd Regiment of Railway Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Fitting the Electric Motor to the Pump

A Practical Discussion on the Application of Electric Drive to a Fundamental Operation in Industrial Plants

By R. H. Rogers
Power and Mining Engineering Department,
General Electric Co., Schenectady, N. Y.

PUMPING is a fundamental operation in all industrial plants which lends itself admirably to electric drive. The selection of pumps, motors and control for the most successful operation is not a simple problem and if not well studied the plant is penalized continuously through the following years. The fact that some of the major industries with well organized engineering departments are operating many pumps with characteristics entirely unfitted for the service would indicate that this branch of engineering needs some explaining, especially for those who have little time for an intensive study of these problems.

The clearest way to show all the elements that affect the overall efficiency of electric pumping units is to analyze the whole span from the electric meter to the work accomplished, not overlooking other items that make an installation successful. The items that directly affect the kilowatt-hours per million gallon-feet are discussed below:

(1) *Ratio of Dynamic to Static Head.*—The vertical tape measurement from level to level or the calculated head, if pumping against boiler pressure, is not the measure of the pump's work. Every foot of pipe, every valve,

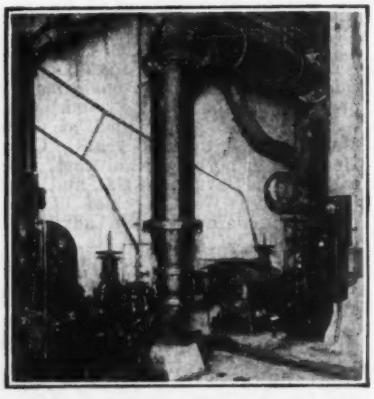


FIG. 1—LIBERAL SIZE OF PIPING REDUCES DYNAMIC HEAD

Sulphite stock centrifugal pumps (2,900 g.p.m., 66-ft. head) direct-connected to motors.

every elbow or other fitting adds to the theoretical to make the actual or dynamic head. For instance, considering only pipe diameter, a 5-in. three-stage centrifugal delivering 400 g.p.m. through 300 ft. of 5-in. pipe will cost $375 per year more to operate than if a 10-in. pipe were used. This differential would pay for the larger pipe in a year. Tables of heads to be added for sizes of pipes, valves and elbows at various velocities are available in pump catalogs and handbooks and they deserve close consideration.

In general, the piping should have much greater area than the pump openings, as high velocity is essential in the pump but detrimental in piping. From 6 to 8 ft. per second should not be exceeded; lesser velocities are desirable, for, once the system is installed,

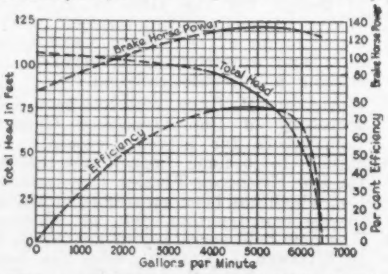


FIG. 2—TYPICAL CURVES FOR 12-IN. CENTRIFUGAL AT CONSTANT SPEED

the loss goes on for years. The suction pipe especially should be deeply immersed, should be as short as is consistent with good installation practice and the bends, if any, should be of long radius. An excess of dynamic head over static head means just that much more work for the motor forever after, and if it is 10 per cent or 50 per cent that excess will show up at the meter.

Fig. 1 shows pump installations with no suction lift as they are placed alongside a sulphite stock tank. The piping is very liberal in size so that the difference between dynamic and static head is slight.

(2) *Pump Characteristics.*—Head, gallons per minute, efficiency, revolutions per minute and horsepower plotted together show the character of a centrifugal pump. If the speed at the point of best efficiency is at or near an induction-motor speed—1730, 1150, 865, 690 or 575 r.p.m.—it will insure its operation at the most efficient point if direct-connected to a squirrel-cage induction motor. If the horsepower required at the most efficient point is near one of the standard squirrel-cage motor ratings—200, 150, 125, 100, 75, 60, 50, 40, 30, or 25 hp.—it will insure a high overall efficiency for the set. Fortunately induction motors have a very flat efficiency curve through the working range, such as 90 per cent at full load; 90.5 per cent at 75 per cent load and 90 per cent at 50 per cent load, so that this feature has little effect. However, the power factors of such motors require that they be operated at near full load to keep the current to a minimum. Power factor affects only the leads and generating system and not the meter, except as the rates may be adjusted to penalize low power factor in a plant. At loads as above, the power factor may be in the order of 89, 87 and 80 per cent.

A desirable characteristic in centrifugal pumps is that of having the load fall off each way from the best operating point. This prevents an overload coming on the motor by an accident or mishandling of valves which would subject it to maximum head (closed off) or minimum head (direct discharge).

Fig. 2 shows typical centrifugal pump curves for constant speed. The efficiency is high and fairly flat from 70 to 97 ft. head and from 4000 to 5600 g.p.m., hence the pump could be efficiently applied between these limits. The horsepower falls off both ways so that the motor cannot be overloaded.

(3) *Operating Off Rating.*—Pumps are rated naturally at their best operating point, and any deviation in speed, head or delivery will result in a higher cost per unit of duty. While some future conditions may have to be given consideration, operating at lower than rated head should be avoided, especially where a constant speed motor is used. Fig. 3 shows the variations in kilowatt-hours per million gallon-feet pumped by a 10-in. centrifugal direct-connected to the constant-speed motor which gives the highest overall efficiency at the pump rating. The gallon-feet pumped in a year at 135-ft. head for $9,100 (2c. per kw.-hour) would cost $17,000 if pumped at 45 ft. head with pumps of this class. This difference of $7,900 per year is not out of line with many pumping duty costs that may be found among the misapplied pumps in industrial plants.

(4) *Choice of Motor.*—For constant-speed service induction motors of the squirrel-cage type or synchronous

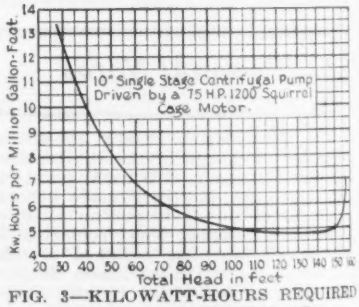


FIG. 3—KILOWATT-HOURS REQUIRED FOR PUMP DRIVEN AT CONSTANT SPEED

motors may be used. Synchronous motors improve the power factor for the plant, and this may be enough to justify the valve manipulation incident to starting centrifugal pumps with such motors, together with the complication of bringing direct-current excitation to the motor. There is little difference in the efficiencies of the motors mentioned. For direct-current service the shunt-wound motor is not well adapted for centrifugal-pump drive as it is too sensitive to load and voltage changes. A compound-wound motor should be used with only a moderate series field, say 10 per cent; such motors have been standardized for centrifugal-pump service.

For adjustable-speed pump drives wound rotor motors, or the brush-shifting, commutator type of motors, may be used. The latter have much higher efficiencies at reduced speeds and this justifies their higher cost if operated at below normal speed frequently or for long periods. Fig. 4 shows the relative outlay in kw.-hours for an adjustable-speed pump using wound rotor and brush-shifting motors. The third curve shows the high cost of throttling to get reduced output. It will be noted that at 60 per cent of normal pump output the brush-shifting motor would operate 24 hours for $10.72; the wound rotor motor for $14.88; the squirrel-cage with throttled pump for $25.20. The differences become greater upon reducing the output still more.

Vertical motors may often be used to great advantage by locating the pump at whatever depth may be necessary below the motor room floor. This reduces or eliminates the suction lift, with consequent benefit to the overall efficiency. Where grit is present in the water or the pump is inaccessible the entire weight of the revolving parts may be carried on a suspension thrust-

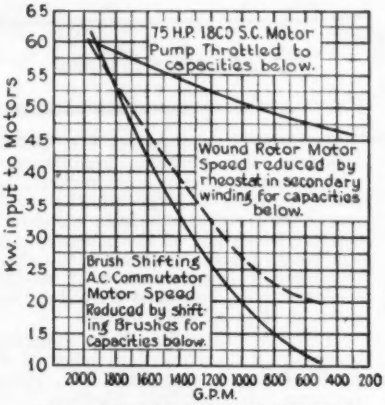


FIG. 4—RELATIVE OUTLAY FOR ADJUSTABLE-SPEED PUMP

bearing at the top of the vertical motor. This allows of easy inspection and maintenance. Vertical motors are available in synchronous, squirrel-cage, wound rotor, brush-shifting and direct-current construction.

Squirrel-cage motors can be used on centrifugal pumps up to 500 hp. provided the inrush of starting current is not objectionable. Wound-rotor motors start with much less line disturbance and are used for that reason even when intended for constant speed duty. Synchronous motors are not usually installed below 75 hp. and are, of course, for constant-speed duty only.

Reciprocating pumps, rotary pumps and screw pumps have heavy starting duty due to highbreakaway torque and full-load pumping duty from start. For these reasons squirrel-cage motors cannot be used if line disturbance is objectionable. Synchronous motors can be used, but the pump must be relieved of its load in starting so that the motor can pull into step. Wound-rotor motors for alterating current and compound-wound motors for direct current are best for pumps of this class, as they are possessed of strong starting characteristics. The brush-shifting commutator type of alternating current motor is equally good where adjustable speed operation is desired.

Pump Control.—Squirrel-cage motors are controlled by manual or automatic compensators to which may be attached disconnecting switches and ammeters. The automatic compensators may be actuated by a push button at some convenient point, by a float switch, by a thermostat or by a diaphragm pressure switch.

Wound-rotor motors for constant-speed duty may be controlled by an automatic panel actuated by push button or by float switch. The heavy starting duty on the reciprocating pumps determines the type of motors used.

Where adjustable speed is required or it is desired to control the starting by hand, a manual rheostat is provided in the secondary circuit while the line contact is made by a manual or magnetic switch. Synchronous motors are commonly controlled by a compensator and a field discharge switch.

Brush-shifting motors require only some form of line switch with overload protection and a mechanical means for shifting the brushes. This may be a hand-wheel, a shipper rod or a small pilot motor actuated by remote push buttons.

Compound-wound, direct-current motors for centrifugal pumps require a disconnecting switch and a hand starter. If adjustable speed is required a manual field regulating rheostat is added.

Direct-current motors may also be controlled by magnetic panels actuated by push button or float switch as in the case of the alternating-current motors. Fig. 6 shows compound-wound motors in a nitrate plant controlled by fused disconnecting switches and hand starters all neatly arranged.

Control apparatus in all cases should be fully enclosed and provided with overload and undervoltage protection. Where it is desired to have the motor restart by itself after an undervoltage shut down, undervoltage release should be specified. Undervoltage release must also be provided if the motor is to be started by a float switch or other auxiliary circuit closing device.

The presence of explosive gases or of especially corrosive acid fumes necessitates the submergence of contact-making parts in oil. Such control items are available for all classes of pump service. For a battery of motor-driven gasoline pumps in a certain refinery the switches are of the oil-immersed type, and as a squirrel-cage motor has no moving contacts there is no danger of starting a fire or explosion.

Pump Service.—In conclusion, it is to be noted that motor-driven pumps are successfully coping with exacting classes of service in industrial plants. Liquids, whether thick, light, volatile or acid, are all being handled under manual or automatic control with the greatest facility. The flexibility of electric drive allows the plant engineer to draw a straight line from level to level, put the pump in the line practically without bends, with the assurance that he can bring the power to the pump without any loss in efficiency or inconvenience to the plant.

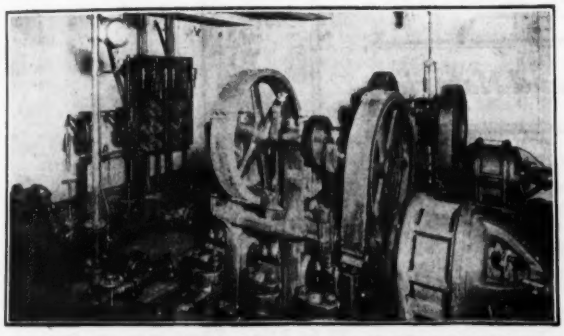


FIG. 5—RECIPROCATING PUMPS REQUIRE HIGH STARTING TORQUE OF WOUND ROTOR MOTORS

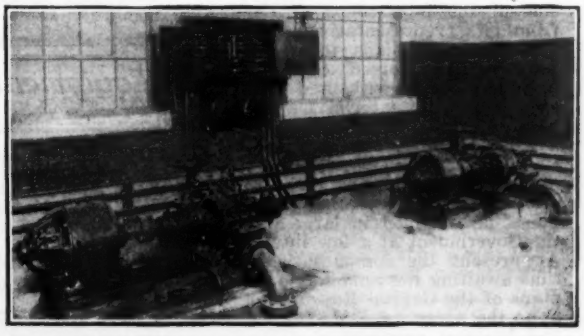


FIG. 6—COMPOUND WOUND MOTORS WITH DISCONNECTING SWITCHES AND HAND STARTERS

American Lumber Commission Sails to Study Japan's Needs

An American commission of lumber exporters sailed from San Francisco Nov. 10 on the Japanese steamship *Taiyo Maru* to study Japan's lumber requirements for reconstruction in the area devastated by the earthquake. The American commission will conduct its survey and negotiations on behalf of more than 100 large export lumber mills in the Pacific Coast region. The commission is composed of Major E. G. Griggs, of Tacoma, Wash., president of the Douglas Fir Exploitation and Export Co.; O. M. Clark, of Portland, Ore., lumber manufacturer, and Chester J. Hogue, of Seattle, manager of the West Coast Forest Products Bureau.

This group of lumber authorities will visit Tokyo, Yokohama and other Japanese cities and confer with Japanese commercial interests identified with plans to furnish emergency supplies of lumber in large volume, and with the least delay possible, to meet rebuilding needs. A special effort will be made by the commission to induce Japanese lumber buyers to accept shipments of American standard lumber sizes.

To Investigate "Dumping" of Foreign Cement

Foreign representatives of the Customs Special Agency Section of the Treasury Department have been instructed to investigate and report as soon as practicable the foreign market values back to April 1 of British, Norwegian, Swedish, Danish and German cement and to forward any other information available bearing on the question of "dumping."

This inquiry results from complaints by the Sun Portland Cement Co. and the Oregon Portland Cement Co. to the collector of customs at Portland, Ore., that cement was being imported from Norway and Sweden at prices below the home market price, thus coming into conflict with the anti-dumping act of 1921.

Tokyo Organizes Huge Building Company for Reconstruction

A huge building construction company is being organized in Tokyo for the purpose of undertaking the construction of commercial and industrial buildings on the unit basis, says a report received by the Far Eastern Division of the Department of Commerce from its representative at Tokyo. This company plans to specialize in four-story reinforced concrete buildings designed to withstand earthquake shocks. Such material as cannot be obtained locally or which cannot be supplied in standard specifications, it is announced, will be obtained abroad.

Funds for the promotion of this new company will, according to present plans, be obtained in large part from the Government at a low interest rate. At present the company is marking time awaiting the announcement of the plans of the Capital Restoration Board as to the areas set aside for industrial and business purposes.

It appears at present, says the Department of Commerce, that in addition to securing abroad a large part of the iron and steel and lumber that goes into the permanent reconstruction, considerable quantities of cement will have to be imported as well. Ordinarily Japan exports considerable cement but the enormous demand that is bound to come with the commencement of permanent building activities, coupled with the destruction of about 8 per cent of Japan's cement production, will be greater than the industry can meet.

The annual capacity of Japan's cement mills was, before the earthquake, in the neighborhood of 14,000,000 bbl. and plans are under way which will, within six months' time, bring this up to 17,000,000 bbl., notwithstanding the losses suffered by the earthquake. Until such time as this increased output is brought about it is expected that the domestic supply will be inadequate and that considerable cement will have to be imported. In anticipation of this need, the Government has placed cement on the free list effective until March 31, 1924.

Conservative bankers in Tokyo are advocating a program of reconstruction spread over a period of 20 years and financed in most part through the flotation of domestic loans. In order to keep the yen on an even keel, however, they favor the flotation of foreign loans sufficient to cover all purchases made abroad.

Business Notes

ORTON & STEINBRENNER CO., 608 So. Dearborn St., Chicago, manufacturer of locomotive cranes and buckets, has just completed a large addition to its works at Huntington, Ind., which will double the output of the company. All equipment for the addition to the plant, including a large number of modern machine tools, has been purchased and most of it is already in use.

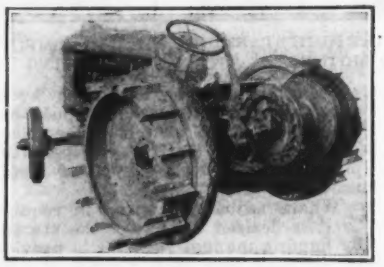
H. B. ACKLAND has been appointed manager of the New York office of the G. H. Williams Co., Erie, Pa., manufacturer of clamshell buckets. Mr. Ackland is a mechanical engineer and was formerly with Westinghouse, Church, Kerr & Co.

C. H. LOOMIS & SONS CO., equipment distributors, Newark, N. J., announces the occupation of a new warehouse at 304-306 Jelliff Ave., housing a line of contractor's plant which includes Rex concrete mixers, Domestic gasoline engines, pumps, hoists and air compressors, and American portable sawmill rigs.

Equipment and Materials

Hoist Attachment for Tractor

A hoist attachment that can be fitted to a Fordson tractor in 15 min. has been added to the line of construction equipment manufactured by the Clyde Iron Works, Duluth, Minn. It consists of a friction-driven drum 8 in.



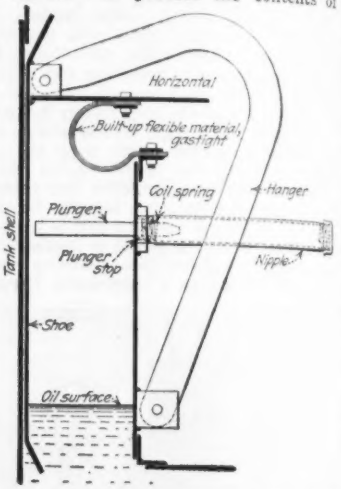
in diameter, 10 in. long between flanges and with 18 in. diameter flanges supported in a cast-steel frame. It is fastened to the tractor by eight of the rear axle housing bolts and two bolts through the outside holes of the drawbar cap. The frame is designed so that no drilling, tapping or machine work of any kind is required to attach it to the tractor and the hoist is mounted so as not to interfere with the tractor in any of its uses.

The drum is equipped with the Clyde standard wood cone frictions and thrust mechanism, bronze bushings with grease cup lubrication, a band-brake that is asbestos-lined and operated by a foot lever and also ratchet with pawl. All shaft bearings are babbitted and lubricated with grease cups, the drum shaft bearings being equipped with removable caps. Power is received through a roller chain from the pulley shaft, the pulley being replaced with a sprocket. A rod on the lever side of the drum gives the operator full control of the throttle.

The hoisting duty of the attachment is 3,900 lb. at 142 ft. per minute for the first layer of ½-in. cable and 2,320 lb. at 242 ft. per minute when the last or seventh layer is on the drum. The hoists are mounted on timber skids for shipment and weigh 600 lb. each, including the tool box.

Floating Roof for Gasoline Tanks

Fire tests were conducted Oct. 16 at the Chicago plant of the Chicago Bridge & Iron Works to prove the ability of the Wiggins floating welded-steel roof to protect the contents of



oil and gasoline tanks. This roof, built for experimental purposes, floated on the surface of gasoline contained in a steel tank 6 ft. high and 30 ft. in diameter. The tank contained about 3 ft. of water on top of which there was an average depth of gasoline of 2½ to 3 in. There is a gas-tight space (see drawing) between the vertical rim of the floating roof and the shoe which presses against the tank shell; this small air space is the only one between the surface of the liquid and the roof. Evaporation is prevented by a special form of seal shown in the accompanying drawing.

In the tests fire applied at numerous points and in different ways failed to start any permanent conflagration. The results, it is claimed, demonstrate not only the fire prevention features of the floating roof but also its value in eliminating evaporation losses.

Publications from the Construction Industry

Metal Lath—ASSOCIATED METAL LATH MANUFACTURERS, Chicago, has published in the form of a 16-p. pamphlet approved specifications for metal lath construction. The specifications cover the quality of material and methods of application of all types. For years manufacturers of metal lath have given out slightly conflicting recommendations on the use of their products. The present set of specifications aims to present, in so far as it is possible to do so, uniform recommendations. In addition to the text, there are a number of drawings showing the use of metal lath in a variety of building construction details, including partitions, ceilings, floors and cornices.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Steel Ingot Output Gains—Slight Drop in Pig Iron

The October steel ingot output showed a gain of nearly 7 per cent, compared with the month preceding, according to the American Iron and Steel Institute. There were 3,382,986 tons produced last month, in the steel mills of the country which turned out 84.15 per cent of the steel ingot output in 1922. The September total was 3,161,964 tons and that for October, 1922, 2,872,415 tons.

Production figures, for the first ten month of the current year, are compared with 1922 in the following table:

Months	Tons of Steel Ingots 1923	1922
January	3,644,629	1,593,482
Feb.	3,294,264	1,745,022
March	3,858,675	2,370,751
April	3,760,997	2,444,513
May	4,000,695	2,711,141
June	3,574,567	2,634,477
July	3,350,829	2,487,104
August	3,506,755	2,214,582
September	3,161,964	2,373,779
October	3,382,986	2,872,415
November	.....	2,889,297
December	.....	2,779,890
Total	35,536,361	29,116,453

The October pig-iron output, however, showed a slight drop from the month preceding. Over 3,149,000 tons were produced last month as against 3,125,000 during September. Compared with the May production peak, the October output dropped 18½ per cent, making it the lowest rate for any month in the current year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 265 to 277, are the following:

Hotel, Durham, N. C., Citizens Hotel Co., $1,000,000.

School, New York, N. Y., Supt. Bd. of Educ., $1,500,000.

Hotel, Ashland, Ky., Buckingham Hotel Co., $1,000,000.

School, Brooklyn, N. Y., Supt. Bd. of Educ., $1,500,000.

Hotel, Paterson, N. J., Alexander Hamilton Hotel, $1,000,000.

Hotel, Duluth, Minn., W. Schroeder, $1,500,000.

High School, St. Louis, Mo., Bd. of Educ., $1,500,000.

Apartment, Philadelphia, Pa., C. E. Oelschlager, $1,500,000.

Hotel, Tacoma, Wash., Citizens Hotel Corp., $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 265 to 277, are the following:

Filter and Admin. Bldg., Cleveland, Ohio, to Stange-Walsh Constr. Co., $2,885,500.

Bank and Office, Cleveland, Ohio, to Fuller Constr. Co., New York City, $5,000,000.

School, Brooklyn, N. Y., Bd. of Educ., to G. Colon and Co., $1,030,000.

Hotel, Long Beach, Calif., to Hennessy Bros., Los Angeles, $1,250,000.

Public Bond Sales Active

The month of October shows greater activity in the bond market than the three preceding months. *The Commercial and Financial Chronicle* reports the total of state and municipal bonds placed at $81,940,676, the highest since June. September of this year placed $51,860,828 and October, 1922, $71,333,536.

The largest issue during October was the $21,000,000 block of Illinois bonds. West Virginia negotiated a sale of $2,000,000 4½s which is a part of a $5,000,000 offering. New York bankers took option on the remainder of the bonds.

Bonds offered but not sold for October totaled $31,000,000.

The total of all the various forms of loans placed in October for the past five years follows:

1919	$108,519,268
1920	170,791,051
1921	189,847,801
1922	163,258,214
1923	347,998,755

In the accompanying table of representative bonds, six were sold at par, four below par, and the remainder above. The yields ranged from 4.201 to 6 and the rate of interest from 4 to 6 per cent.

Next week—"Water-Works Installation in 1922 and 1923"

REPRESENTATIVE BOND SALES DURING OCTOBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Missouri	Roads	$5,000,000	4½	99.449	4.59	Nov. 1, 1923	1928—1932	First Nat. Bank of N. Y. and others
West Virginia	Highway	2,000,000	4½	100	4½	Sept. 29, 1923	.....	National City Co., N. Y. and others
County								
Dade, Fla.	Highway	335,000	5	98.18	5.15	Oct. 1, 1923	1925—1954	R. M. Grant & Co., New York City
Douglas, Minn.	Ditch	60,000	4½	100	4½	Oct. 1, 1923	1929—1943	Minn. Loan & Trust Co., Minneapolis
Geauga, O.	Refund	4,000	6	100.37	5.91	Oct. 1, 1923	1924—1931	Chagrin Banking Co., Chagrin Falls, O.
Hancock, Ind.	Roads	4,400	5	101.14	4.75	Sept. 15, 1923	1924—1933	Citizens Bank, Greenfield, Ind.
Henderson, N. C.	Refund	80,000	6	100	6	Sept. 15, 1923	1929—1944	Nat. Bk. of Commerce, New York City
Knox, Ind.	Drainage	9,247.87	6	100.56	5.89	Oct. 1, 1923	1925—1934	W. M. Alsop, Vincennes, Ind.
Luzerne, Pa.	Bridge	350,000	5	101.28	4.57	Nov. 1, 1923	1925—1928	Biddle & Henry, Philadelphia, Pa.
Penniscot, Mo.	Drainage	32,000	6	101.77	5.84	Oct. 1, 1923	Oct. 1, 1943	Liberty Central Trust Co., St. Louis, Mo.
Polk, Minn.	Ditch	80,500	5	101.40	4.93	Nov. 1, 1923	1932—1953	Northwestern Trust Co. and others, Minneapolis
Warren, Ind.	Road	17,850	5	100.96	4.80	Oct. 1, 1923	1924—1933	Warren Co. Bank, Williamsport, Ind.
Municipality								
Albermarle, N. C.	Water	90,000	6	104.55	5.64	Nov. 1, 1923	1926—1963	Keane, Higbie & Co., Detroit, Mich.
Arlington, Mass.	School	88,000	4½	101.929	4.22	Nov. 1, 1923	1924—1938	Merrill, Oldham & Co., Boston, Mass.
Brockton, Mass.	Water and street	110,000	4½	100.048	4.24	Oct. 1, 1923	1924—1943	F. S. Moseley & Co., Boston, Mass.
Claremont, N. H.	Water	75,000	4	95.21	4.201	Nov. 1, 1923	1924—1943	Merrill, Oldham & Co., Boston, Mass.
Clyde, O.	Electric plant	17,000	6	103.77	5.40	Oct. 1, 1923	1925—1934	Detroit Trust Co., Detroit, Mich.
Concord, N. C.	Street improvement	88,000	5½	101.06	5.37	July 1, 1923	1923—1944	Seasongood & Mayer, Cincinnati, O.
Cuyahoga Falls, O.	Water and streets	76,769	6	101.11	5.73	Oct. 1, 1923	1924—1932	Seasongood & Mayer, Cincinnati, O.
Dallas, Tex.	Streets	1,250,000	4½	100	4½	May 1, 1923	1924—1963	Geo. H. Burr & Co. and others, N.Y.C.
Gastonia, N. C.	Water, streets, sewers	500,000	5½	100.54	5.21	Aug. 1, 1923	1925—1964	Kissel, Kinnicut & Co., & Wm. R. Compton Co., New York City
Grandview Heights, O.	Water, street imp'vt.	27,900	5½	100.38	5.42	Oct. 30, 1923	1925—1934	Citizens Trust & Savings Bank, Columbus, O.
Lakewood, O.	Paving	201,676	5	100	5	Oct. 1, 1923	1925—1932	Wm. A. McHugh & Co., Cleveland, O.
Laramie, Wyo.	Sewer	112,000	5	100.20	4.99	Nov. 10, 1923	1933—1953	Highway Constr. Co., Elyria, O.
Madison, Wis.	Water	50,000	4½	97.85	4.67	Oct. 1, 1923	Oct. 1, 1943	Albany Nat. Bank, Laramie, Wyo.
Mooresville, N. C.	Water	200,000	5½	100	5½	Oct. 1, 1923	1924—1963	Blyth-Witter & Co., Madison, Wis.
Orville, O.	Water	60,000	5½	'01.56	5.17	Oct. 1, 1923	1924—1933	Amer. Trust Co., Charlotte, N. C.
Sanford, N. C.	Street, water, sewer	225,000	5½	100.10	5.48	Oct. 15, 1923	1924—1958	Sidney Spitzer & Co., Toledo, O.
Scarsdale, N. Y.	Fire house	50,000	4½	103.17	4.47	May 1, 1923	1928—1952	Wachovia Bk. & Trust Co., Raleigh, N. C.
Township								
Greensboro School, Twp., Ind.	School	30,000	5	100.005	4.999	.....	.....	Sherwood & Merrifield, New York City
Webster Twp., Rural School Dist., O.	School	$12,087.03	6	100.11	5.97	Oct. 1, 1923	1924—1931	J. F. Wild & Co., Indianapolis, Ind.
								Ryan Bowman & Co., Toledo, O.

Ten Largest 1923 Contracts Total $85,328,722

From contracts awarded published in *Engineering News-Record*, the ten largest to date are given in an accompanying table. Three of these are in New York City with a total of $23,226,086, while Chicago with three, totals $21,602,636. The remaining contracts are not located in commercial centers. It is also noteworthy that on the whole, contracts were awarded to contractors located in the centers where the construction was done. Also out of the nine classifications into which the types of construction are divided in Construction News, six of them are represented in this list. The largest was for a $20,000,000 power plant in New Jersey.

TEN LARGEST CONTRACTS—JAN. 1 TO NOV. 1, 1923

1923		Work	Location	Price	Successful Contractor
Feb.	1	Office	New York City	$6,000,000	F. T. Ley & Co., New York City
Feb.	8	Office	Chicago	8,000,000	Starrett Bros., Chicago
Apr.	5	R. R. & telegraph system	Montana	12,000,000	Peterson-Shirley & Gunther, Omaha, Nebraska
June	7	Subway	New York City	5,976,086	Patrick McGovern, New York City
June	28	Telephone Exchange	New York City	11,250,000	Marc Eidlitz & Son, Inc., New York City
July	12	Office	Chicago	8,000,000	Wells Bros. Constr. Co., Chicago
Aug.	16	Sewage works	Chicago	5,602,636	J. Griffiths & Sons Co., Chicago
Sept.	6	Dam	Danville, Ky.	4,000,000	L. E. Meyer, Chicago
Sept.	13	Bridge	California	4,500,000	Duncanson-Harrelson, San Francisco
Oct.	18	Power plant	Kearny, N. J.	20,000,000	Pub. Service Prod. Corp., Newark, N.J.
		Total		$85,328,722	

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	63.60	54.75	61.00	57.20@60.20	60.50	69.00	61.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.55@2.65	2.60	2.05	2.20	2.50	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	39.00	54.75	57.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	22.55@23.65	11.00	+11.60	11.00	16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.110	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	.97	—1.05	1.14	.99	1.12	1.08	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

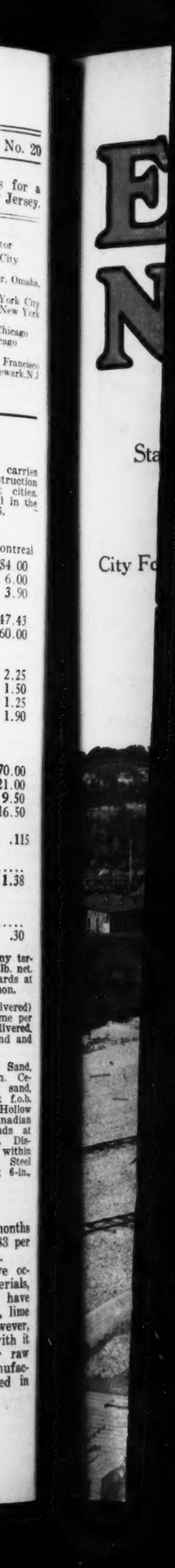
San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.28). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Changes Since Last Week

Recent price reductions in basic building materials have resulted partly from seasonal influences and partly from plentiful supplies. These concessions have resulted in an unusually large winter building program in all classes of construction. Federal Government projects especially, having been held up for some time, will enter the market at a time when competition for labor and materials is not so keen.

While the construction outlook is well-defined, the same cannot be said of business generally. The stock market has improved recently; money is fairly easy; freight loadings are unseasonably heavy; the recent steel dividend indicates an optimistic outlook in that industry, yet foreign exchange rates have dropped still further; curtailment has occurred in the pig-iron, textile and leather output and freight rate reductions on grain and coal remain unsettled. Shipments of locomotives from the principal manufacturing establishments to the various railroads, during the first ten months of the current year, increased 183 per cent over the same period in 1922.

The declines referred to have occurred mostly in concreting materials, lumber and clay products, and have not affected such items as steel, lime and labor costs. Linseed oil, however, has steadily declined carrying with it paint prices in general. Other raw materials entering into the manufacture of paint have not declined in proportion.